
A REVIEW OF THE NATIVE NORTH AMERICAN BEES OF THE GENUS *CHALICODOMA* (HYMENOPTERA: MEGACHILIDAE)

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ABSTRACT. The five subgenera of *Chalicodoma* known to be present in the Western Hemisphere are separated in a key. The subgenera *Callomegachile*, *Carinella*, and *Pseudomegachile* are adventive and not treated further. There are two native subgenera. *Chelostomoides*, with about two dozen species, ranges from southern Canada to Peru. The new subgenus *Chelostomoidella* (type-species: *Megachile spinotulata* Mitchell) is monotypic and is limited to arid and semiarid regions of western North America.

The North American species of *Chelostomoides* are separated in a key, and pertinent features of each species are illustrated. Previously treated as a synonym of *C. occidentalis*, *C. prosopidis* is recognized as a valid species in the United States and northern Mexico; *C. occidentalis* is limited to Lower California, Mexico. The following NEW SYNONYMY is proposed: *C. ignacensis* = *C. occidentalis*; *C. wilmingtوني* = *C. campanulae*; *C. gualanensis* = *C. abacula*; *C. exilis* var. *parexilis* = *C. exilis*; and *C. subspinotulata* = *C. spinotulata*.

The following new species are described: *C. axyx* (Costa Rica), *C. alucaba* (Mexico), *C. asymmetrica* (Mexico), *C. ecplectica* (Mexico), and *C. reflexa* (Mexico).

Distributions and host plant associations of each species are briefly discussed.

INTRODUCTION

Chelostomoides is a native New World subgenus of *Chalicodoma* Lepeletier, 1841, a primarily Old World genus of megachiline bees. Originally described as a genus by Robertson (1901), *Chelostomoides* was treated as a subgenus of *Megachile* Latreille, 1802, by Mitchell (1934, 1937, 1956) and most subsequent authors. However, Michener (1962) reviewed the higher groupings of the non-parasitic megachilines and removed *Chelostomoides* to *Chalicodoma* as a subgenus. The only other native New World group of *Chalicodoma*, as redefined by Michener, was the South American subgenus *Stelodides* Moure, 1953. A further refinement of the New World Megachilini was presented by Mitchell (1980), who recognized seven genera; *Stelodides* was transferred to the genus *Chrysosarus* Mitchell, 1943, leaving *Chelostomoides* as the sole native New World representative of *Chalicodoma*. Three Old World subgenera of *Chalicodoma* are represented in the Caribbean re-

gion by adventive species, one of which is now apparently established in southern Florida.

The present study was initiated to update published information on some species of *Chelostomoides*, primarily to establish a few new synonyms and to amplify known distributions of a few species. That very modest intent was soon abandoned with the discovery of several new species. Thus, the new key to the known North American species bears little resemblance to that of Mitchell (1956).

SPECIMENS EXAMINED

During this study, specimens from the following collections have been examined.

Arizona State University (ARSU)
Bee Biology and Systematics Laboratory, USDA,
Logan, Utah (BBSL)
California Academy of Sciences (CAS)
California Department of Food and Agriculture
(CDFA)
K.W. Cooper, personal collection (KWC)
Florida State Collection of Arthropods (FSCA)
J.A. Halstead, personal collection (HALS)
Museum of Comparative Zoology (MCZ)

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Natural History Museum of Los Angeles County (LACM)

J.L. Neff, personal collection (NEFF)

San Diego Natural History Museum (SDM)

G.I. Stage, personal collection (GIS)

Texas A&M University (TAMU)

United States National Museum of Natural History (USNM)

University of Arizona (UNAR)

University of California, Berkeley (UCB)

University of California, Davis (UCD)

University of California, Riverside (UCR)

University of Kansas (UKAN)

Washington State University (WASH)

SPECIMEN DATA

New data on distribution, capture dates, and plant associations are fully cited for those species for which there are few published records. Localities are organized by country, from north to south, and alphabetically by state, province, or department within that country. The designation "state," "department," or "province" is omitted to conserve space. Thus, a locality cited under "MEXICO, PUEBLA" is from the State of Puebla of Mexico.

For species that are widely distributed and common, thus well known, only general range is indicated.

Such floral data as are presently available, both from previous literature and from new records, are included for all species. These floral records are arranged alphabetically by families and by genera within families. When records are from four or more species within a floral genus, they are cited thus: *Penstemon* (5 spp.). To the extent that it has been feasible to do so, I have cited floral records using current botanical nomenclature. Therefore, the woody species once included in *Dalea* (Fabaceae) are now placed in the related genus *Psoralea* and are cited under the latter name.

TERMINOLOGY

In general, the morphological terminology employed here is conventional within apoid systematics and the Megachilini (Michener, 1944, 1965; Mitchell, 1935, 1980). Mandibular terminology follows Michener and Fraser (1978).

When the last tergum (6) of the female is viewed in profile, there is a strongly sloping basal face and an oblique posterior rim. The juncture of the two is usually more or less evenly curved. In some species a distinct transverse groove is present, and its posterior margin is marked by a raised carina. When the transverse carina is present, the groove is also present. One species does possess a more or less definite groove, but with no evidence of a carina; this species is placed among those that lack a transverse groove. *Only when both modifications are evident is the transverse groove said to be present.*

The male protarsi are often modified, either broad and flat, or more or less widened and with the anterior and posterior margins curled inward so that the glabrous inner surface appears to be longitudinally grooved. Most species with the latter type of basitarsus possess a unique feature that I have not seen elsewhere among the Megachilini. A cluster of several exceptionally long setae arises at the extreme base of the posterior margin of the basitarsus. The setae are closely appressed to one another for most of their lengths but become separate near their apices; thus, they have the appearance of a single, very long seta, plumose at the apex (Fig. 23). Because of its appearance, I have termed this cluster of setae the *mastigion*, the Greek word for a scourge or whip. In repose, the mastigion commonly lies prostrate along the posterior margin of the probasitarsus, but it may be deflected nearly at right angles to the segment.

The measurements used in the descriptions are those usual to bee systematics and require little explanation beyond that given here.

Head length (HL) is measured with the head in full frontal view and does not include either the labrum or the mandibles; it is measured from the visible dorsal (upper) margin of the vertex to the ventral (apical) margin of the clypeus, including any protuberances of the clypeal margin.

Lower interorbital distance (LID) is the minimum distance between the inner eye margins.

Upper interorbital distance (UID) is the maximum distance between the inner eye margins, usually at about the level of the ocelli.

Flagellar segments are measured along their minimum length.

Wing length (WL) is measured along the costa, from the margin of the tegula to a point opposite the apex of the wing.

SYSTEMATICS

Chalicodoma is used here as defined by Michener (1962): "Mandible of female without cutting edges between teeth (except in *Chelostomoda*, which has one in second interspace only); metasoma strongly convex dorsally, more or less parallel-sided; metanotum separated from propodeum by a suture which is often as conspicuous as scutellar-metanotal suture (except in the subgenus *Chelostomoides*); sublaterally metanotum usually but little narrowed; axillar fossa deep, its posterior face usually ascending to strong scutellar crest between fossa and metanotum; eighth metasomal sternum of male with marginal hairs." Additionally, New World *Chalicodoma* usually possess deep postgradular grooves on metasomal terga 2-4, and in males metasomal sterna 4-8 are usually retracted and hidden. The following new key to the subgenera of *Chalicodoma* now known to be present in the New World is a modification of that of Mitchell (1980). The adventive subgenera *Callomegachile*, *Carinella*, and *Pseudomegachile* are not further treated here.

KEY TO NEW WORLD SUBGENERA OF *CHALICODOMA*

- 1a. Male; antenna 13-segmented; scopa absent 2
- b. Female; antenna 12-segmented; scopa present on metasomal sterna 6
- 2a. Metasoma with three exposed sterna; basal metasomal terga without fulvous pubescence or tomentum 3
- b. Metasoma with four exposed sterna; at least first two metasomal terga with fulvous pilosity 4
- 3a. Ventral margin of mandible simple (Fig. 15) or with triangular process (Fig. 18) at about mid-length; procoxa conspicuously pilose beneath, simple, or with more or less spine-like distal process *Chelostomoides*
- b. Ventral margin of mandible with large basal process (Fig. 17); procoxa glabrous beneath and with both proximal and distal spine-like processes *Chelostomoidella*
- 4a. Protarsus slender and unmodified, probasitarsus pilose on inner surface; fifth and sixth metasomal terga without fulvous pilosity 5
- b. Protarsus dilated, probasitarsus with glabrous excavation along anterior, inner margin; fifth and sixth metasomal terga with fulvous pilosity *Callomegachile*
- 5a. Metasomal terga 3–5 with complete, white, apical pubescent fasciae; lower margin of mandible with small process before middle; gena without posterior marginal carina *Pseudomegachile*
- b. Metasomal terga without fasciae of white pubescence; lower margin of mandible simple; gena with posterior carina *Carinella*
- 6a. Without fulvous pubescence on head, mesosoma, and basal terga; mandible various, but often elongate and slender, clypeus often grotesque 7
- b. Fulvous pubescence present at least on head, mesosoma, and first two metasomal terga; mandible always broadly triangular, clypeus never grotesque 8
- 7a. Tergum 6 without preapical groove or, if present, basal face does not project over groove; mandible often long and slender and clypeus often grotesque; mandibular trimma flat, not covered by transparent lamella *Chelostomoides*
- b. Tergum 6 with deep preapical groove and basal face projecting over groove; mandible triangular and clypeus with apical excavation and median tubercle; mandibular trimma with basal depression, covered, in part, by transparent lamella *Chelostomoidella*
- 8a. Clypeus, in profile, weakly convex from base to apex and disc with a more or less definite median impunctate line; distal metasomal terga without fulvous pilosity 9
- b. Clypeus, in profile, distinctly beveled and disc

without traces of median impunctate line; all metasomal terga with fulvous pilosity

- *Callomegachile*
- 9a. Median line of clypeus cariniform; posterior margins of metasomal terga 3–5 without white pubescent fascia *Carinella*
- b. Median line of clypeus smooth and impunctate but not cariniform; metasomal terga 3–5 with fascia of white pubescence *Pseudomegachile*

Chelostomoides Robertson

Chelostomoides Robertson, 1902:231. Type-species: (*Megachile rufimanus* Robertson, 1891) = *Chelostoma rugifrons* F. Smith, 1854. Monobasic and original designation.

Oligotropus Robertson, 1903:168. Type-species: *Oligotropus campanulae* Robertson, 1903. Monobasic and original designation.

Gnathodon Robertson, 1903:168. *Preoccupied*. Type-species: *Megachile georgica* Cresson, 1878. Monobasic and original designation.

Sarogaster Robertson, 1918:92. New name for *Gnathodon* Robertson, 1903.

Megachile subg. *Chelostomoides*: Mitchell, 1934: 306, 309. Mitchell, 1937:382. Michener, 1944: 266, 267.

Chalicodoma subg. *Chelostomoides*: Michener, 1962:20. Michener, 1965:193–195. Mitchell, 1980:13, 30–39.

The subgenus *Chelostomoides* is here recharacterized to provide a comparison with the new subgenus *Chelostomoidella*, described below.

DIAGNOSIS

Differs from *Chelostomoidella*, the only other native North American subgenus of *Chalicodoma*, by the following combination of characters: trimma of mandible flat, without overlying transparent lamella; mandible of male with ventral process, when present, at or beyond midlength; procoxa of male pubescent, ventral process, when present, at apex only; male mesosternum simple; female mandible with outer ridge and secondary ridge low and indistinct; female sternum 6 without preapical groove or, if present, basal face does not overhang groove in profile view.

DESCRIPTION

FEMALE. [1] Mandible long and slender, or short and broad; apical margin with three or four teeth, rarely with five teeth; outer ridge weak to moderate, often evanescent or interrupted beyond proximal one-third, secondary ridge weak beyond basal one-third and interspace broad and shallow, or (in long-mandible species) both ridges essentially absent; trimma flat, without overlying transparent, pros-

trate lamella. [2] Clypeus flat to moderately convex, rarely strongly convex at base, apical margin usually overhanging base of labrum (if not, disc is bizarrely modified) and simple or variously emarginate, denticulate, or tuberculate. [3] First flagellar segment shorter than second. [4] Lower genal area simple or with small tubercle behind base of mandible.

[5] Meso- and metabasitarsi shorter and narrower than corresponding tibiae; tarsal claws simple or obscurely dentate near base.

[6] Metasoma parallel-sided; tergum 6 without preapical groove or preapical groove present and followed by transverse carina.

MALE. [7] Mandible broad to slender, tridentate, inner tooth usually larger than middle tooth, and usually perpendicular to outer margin; process of ventral margin, when present, at or beyond mid-length; trimma flat, without overlying transparent lamella. [8] First flagellar segment shorter than second.

[9] Procoxa pubescent or sparsely setose beneath; spine-like process, when present, distal. [10] First three protarsal segments simple or, when modified, without deep channel-like groove on anterior margins of first two segments. [11] Meso- and metabasitarsi shorter and narrower than corresponding tibiae; tarsal claws symmetrical.

[12] Preapical carina of tergum 6 shallowly emarginate, or short-bidentate; lateral and, especially, submedian teeth of posterior margin often low and convex. [13] Sternum 3 without median row of setae simulating a carina. [14] Sternum 4 usually fully retracted, simple. [15] Sternum 5 with species-characteristic patterns of bizarre setae; metasternite not extended over portions of presternite. [16] Sternum 6 with various species-characteristic patterns of bizarre setae; poststernite much shorter than median length of metasternite, apical margin usually transverse. [17] Gonocoxite various, but usually cylindrical or subcapitate distad, rarely compressed. [18] Outer lobe of volsella various, but not notably long and slender. [19] Aedeagus usually ending at same level as gonocoxite, or shorter, normally uniformly pigmented.

DISCUSSION

For the differences between *Chelostomoides* and *Chelostomoidella*, see the discussion under *Chelostomoidella*. These two are the only native North American subgenera of *Chalicodoma*. One species of *Chalicodoma* is adventive in the United States from India: *C. (Pseudomegachile) lanata* (Fabricius). Both sexes of that bee have abundant fulvous pubescence on the head, mesosoma, and first two terga; the male, in addition, has four exposed abdominal sterna. This species is known in the United States only from Florida, presumably introduced from Cuba (Hurd, 1979).

Michener (1965) has discussed the many similarities between *Chelostomoides* and the Australian

subgenus *Hackeriapis* and expressed the opinion that further study may necessitate combining the two groups. Because I have not had the opportunity to examine many of the Australian forms, I can add no further comment.

Stephen, Bohart, and Torchio (1969) proposed to treat *Chelostomoides* as a genus "... not particularly closely related to *Chalicodoma*." Because they stated that the range of *Chelostomoides* includes Eurasia as well as the New World, presumably their interpretation includes at least some of the Old World species presently assigned to *Hackeriapis*. The primary justification for this proposal apparently is the modified and concealed fourth sternum of male *Chelostomoides*.

The character of sternum 4 of the males cannot, of itself, be adequate justification for removal of *Chelostomoides* from *Chalicodoma*, and no other supporting characteristics were cited. It should be noted that some *Chelostomoides* (e.g., *C. davidsoni*, *C. prosopidis*, *C. occidentalis*) have sternum 4 incompletely concealed. Nor do all species possess specialized, capitate hairs on sternum 5. Although Michener (1965) may well be correct in suggesting that *Hackeriapis* and *Chelostomoides* should be combined, it does not follow that generic status is justified for the enlarged *Chelostomoides*.

Chelostomoides is a primarily North American group, with most of the species occurring in the southwestern United States and adjacent Mexico. Michener (1954) recorded no species from Panama, although three species do reach Costa Rica. Three species have been previously reported in South America: *C. cartagenensis* (Mitchell, 1930) (Colombia), *C. haematoxylonae* (Mitchell, 1930) (Colombia), and *C. peruviana* (F. Smith, 1879) (Peru). I have not examined material of any of these species, and they are not dealt with further in this paper; all are included in the key to species of *Chelostomoides* by Mitchell (1956).

Females of *Chelostomoides* often have the clypeus and mandibles grotesquely modified. Although it has been generally assumed that these are adaptive traits, there has never been any observational evidence to bolster the assumption. The observation recently published by Messer (1984), although made on the Indonesian *Chalicodoma pluto* (F. Smith), may very well be applicable to species of *Chelostomoides*: "Facing upward, a female loosened resin with the mandibles, then scraped it up using the elongate labrum in the manner of a bulldozer blade. The ball of resin which formed was held in place between the tree and the labrum while being progressively enlarged ... the labrum was [also] observed to act as a lever, applying tension to a load in the mandibles and possibly helping to secure it during flight."

The species of *Chelostomoides*, so far as known, also use plant resin in nest construction. It seems probable that the clypeal and mandibular modifications may be similarly employed. Because some species of *Chelostomoides* do possess normal, stout

mandibles and an essentially simply clypeus, the method of gathering resin may be different.

KEY TO NORTH AMERICAN
CHELOSTOMOIDES

- 1a. Male, antenna 13-segmented and metasoma with three exposed sterna, scopa absent . . 2
- b. Female, antenna 12-segmented and metasoma with five exposed sterna, scopa present . . 25
- 2a. *Either*: (a) ventral margin of mandible without triangular process or (b) protarsi flat and broad or expanded and curled with inner surface concave and without pilosity 3
- b. Ventral margin of mandible with small triangular process at midlength and protarsi slender and simple with inner surface densely hirsute *armaticeps* (Cresson)
- 3a. Ventral margin of mandible without tooth or protuberance (Fig. 15); procoxa without distal spine or process on ventral surface; protarsus not flattened and expanded, not excavated beneath 4
- b. Ventral margin of mandible with large tooth or protuberance, often hidden by dense hairs (Fig. 18); procoxa commonly with ventral process or spine distad; two or more protarsal segments commonly flattened and broadened, often excavated beneath 15
- 4a. Carina of tergum 6 either bidentate or bilobate, not narrowly protuberant (Figs. 4-8, 11, 12); clypeus and frons usually dull and contiguously punctate, but if punctures are distinctly separated, puncture diameter on basal half of clypeus exceeds 0.035 mm 5
- b. Carina of tergum 6 narrowly protuberant in middle and with apex bidentate (Fig. 9); clypeus and frons shiny between fine, dense punctures, those of clypeus less than 0.03 mm in diameter *lobatifrons* (Cockerell)
- 5a. Lateral angles of middle lobe of clypeus tuberculiform or dentiform, emargination between them with median tooth (Fig. 1); carina of tergum 6 low and inconspicuous, weakly emarginate in middle (Fig. 4); apical margin of tergum 6 without lateral or submedian lobes or processes 6
- b. Lateral angles of middle lobe of clypeus low and broadly rounded, emargination between them broad and shallow, without median tooth (Figs. 2, 3); carina of tergum 6 commonly bidentate, but if low and inconspicuous, at least lateral teeth evident on apical margin 8
- 6a. Clypeus with conspicuous black hairs interspersed among dense white hairs; terga 4 and 5 commonly densely tomentose (often abraded); median tubercle of clypeal margin subequal to, or larger than, flanking tubercles (Fig. 1) 7
- b. Clypeus without interspersed black hairs; terga 4 and 5 with only scattered tomentum on discs; median tubercle of clypeal margin conspicu-

- ously smaller than flanking tubercles *manni* (Mitchell)
- 7a. Middle process of clypeal margin about as long as lateral processes; mandible without tooth-like process below third tooth (Fig. 14); long, black hairs conspicuous on clypeus, frons, and vertex *abacula* (Cresson)
- b. Middle process of clypeal margin much more prominent than lateral processes (Fig. 1); mandible with tooth-like process below third tooth on inner side (Fig. 20); black hairs inconspicuous on clypeus and vertex, absent from frons *alucaba*, new species
- 8a. Carina of tergum 6 conspicuously bidentate (Fig. 11); clypeus and frons shiny between distinctly separated punctures 9
- b. Carina of tergum 6 low and inconspicuous, weakly emarginate or emargination no broader than flanking teeth (Fig. 7, 8); clypeus and frons dull to slightly shiny, contiguously to subcontiguously punctate 11
- 9a. Teeth of carina of tergum 6 separated by two or more times their basal width; mesoscutum with distinct anterolateral patch of flocculent white hairs 10
- b. Teeth of carina of tergum 6 separated by about their basal widths (Fig. 13); mesoscutum without anterolateral patch of flocculent white hairs *adelphodonta* (Cockerell)
- 10a. Clypeus flat, uniformly covered with white hairs; punctures of parapsidal area distinctly separated; ocellocular area with punctures of diverse size and very variable spacing *discorhina* (Cockerell)
- b. Clypeus broadly convex over basal one-half or more, hairs white, with interspersed suberect, long, brown to blackish hairs; punctures of parapsidal area contiguous; ocellocular area uniformly subcontiguously punctate, punctures coarser near eye *chilopsidis* (Cockerell)
- 11a. Punctures of vertex about equal to those of mesoscutum; posterior ocelli about as far from eye as from margin of vertex 12
- b. Punctures of vertex distinctly coarser than those of mesoscutum; posterior ocelli distinctly nearer to eyes than to margin of vertex *rugifrons* (F. Smith)
- 12a. Frons slightly shiny, punctures contiguous but distinct; mesoscutum with anterolateral patches of flocculent white pubescence; discs of sterna 2 and 3 not tomentose 13
- b. Frons dull, rugosopunctate, few punctures distinct; mesoscutum without anterolateral flocculent hair patches; discs of sterna 2 or 3 more or less covered with white tomentum . . . 14
- 13a. Lateral emarginations of clypeal margin deep, middle portion of margin nearly straight, but depressed in center (Fig. 2); second flagellar segment about four times longer than first, equal to third *browni* (Mitchell)
- b. Lateral and median emarginations of clypeal

- margin about equal, shallow (Fig. 3); second flagellar segment shorter than third, about three times longer than first *odontostoma* (Cockerell)
- 14a. Legs usually wholly ferruginous beyond coxae; pro- and mesobasitarsi each with distinct posterior fringe of very long hairs which are longer than segment (Fig. 25) ... *axyx*, new species
- b. Legs dark brownish, tarsi usually lighter; pro- and mesobasitarsi without posterior fringes, hairs always distinctly shorter than segment (Fig. 26) *texensis* (Mitchell)
- 15a. Protarsal segments broad, flat, and with short, appressed pubescence on outer and inner surfaces 16
- b. Protarsal segments slender or moderately broadened, inner surface of first three segments concave and glabrous 18
- 16a. First and second protarsal segments densely tomentose beneath, second with small apu- bescent area; procoxal process conical, little, if any, longer than wide at base 17
- b. First protarsal segment with numerous ordi- nary hairs beneath, not at all tomentose, sec- ond segment largely glabrous, with fine to- mentum along margins; procoxal process at least twice as long as broad at base *georgica* (Cresson)
- 17a. Distal segment of protarsus much longer than probasitarsus; clypeus with prominent carina- like median ridge, at least near apical margin; ocellocular distance much less than ocelloc- ipital distance *davidseni* (Cockerell)
- b. Distal segment of protarsus no longer than probasitarsus; clypeus nearly flat, without car- iniform median ridge; ocellocular distance about equal to ocellocipital distance *occidentalis* (W. Fox) and *prosopidis* (Cockerell)
- 18a. Probasitarsus with short row of slender, api- cally recurved setae on anteroventral margin; procoxal process prominent 19
- b. Probasitarsus without apically recurved setae at base of anteroventral margin; procoxal pro- cess various, often vestigial 20
- 19a. Discs of fourth, fifth, and sixth terga with abundant appressed, yellowish pubescence .. *otomita* (Cresson)
- b. Discs of fourth, fifth, and sixth terga with sparse, mixed short and long, dark, simple hairs only *reflexa*, new species
- 20a. Disc of procoxa mostly covered with very short, simple, yellowish to fuscous, decumbent hairs 21
- b. Disc of procoxa mostly covered with long, plumose, white, suberect or erect hairs .. 22
- 21a. Distal process of procoxa prominent, conoid, usually at least as long as broad at base; pro- notal collar with lateral patch of long, flocc- ulent hairs *subexilis* (Cockerell)
- b. Distal process of procoxa short, broader at base than high; pronotal collar without dense patch of flocculent hairs *angelarum* (Cockerell)
- 22a. Mastigion present; distal process of procoxa absent or minute; discs of terga 5 and 6 with or without appressed, pale, plumose hairs .. 23
- b. Mastigion absent; distal process of procoxa distinct, as long as, or longer than, broad at base; discs of terga 5 and 6 with appressed, pale, plumose hairs *asymmetrica*, new species
- 23a. Protibia without longitudinal carina on pos- terior face, or, if present, it is limited to less than distal one-third; disc of procoxa densely tomentose and distal process absent; anterior and posterior margins of probasitarsus diver- gent distad 24
- b. Protibia with longitudinal carina from near apical spur almost to base; disc of procoxa with well-separated, long, plumose hairs and minute distal process; anterior and posterior margins of probasitarsus subparallel *campanulae* (Robertson)
- 24a. Third protarsal segment broader than long and no longer than second segment (Fig. 23); gon- ocoxite about as broad at midlength as at apex; discs of terga 5 and 6 without appressed, pale, plumose hairs *exilis* (Cresson)
- b. Third protarsal segment longer than broad and longer than second segment (Fig. 24); gon- ocoxite conspicuously broader at apex than at midlength (Fig. 29); discs of terga 5 and 6 with numerous short, appressed, pale, plumose hairs *quadridentata* (Mitchell)
- 25a. Clypeus without erect T-shaped apical process, but may be otherwise modified; supraclypeal area without erect curved process 26
- b. Clypeus with erect T-shaped process and sup- raclypeal area with large curved process (Fig. 75) *armaticeps* (Cresson)
- 26a. Tergum 6 with preapical groove; mandible stout, approximately triangular, cutting margin quadridentate and more than one-half as long as lower margin (Figs. 51-53) 27
- b. Tergum 6 without preapical groove; mandible often elongate (Figs. 50, 65), but may be stout and quadridentate as above 33
- 27a. Clypeus evenly convex, not bowed across mid- dle, apical margin variously excavated and den- ticulate or tuberculate 28
- b. Clypeus transversely bowed across middle, lower facet oblique and nearly impunctate, apical margin straight, simple (Fig. 53) *manni* (Mitchell)
- 28a. Clypeal margin variously tuberculate or den- ticulate, but if submedian tubercles are present (one species), margin laterad of tubercles is not concave and tergum 5 lacks apical, pubescent fascia 29
- b. Clypeal margin with strong submedian and lat- eral tubercles separated by deep emargination;

- tergum 5 with apical, pubescent fasciae
..... *subexilis* (Cockerell) 37
- 29a. Apical margin of clypeus with deep median emargination flanked by more or less distinct tubercles or denticles (Fig. 51), and without median tubercle 30
- b. Apical margin of clypeus with shallow median emargination and median tubercle (Fig. 52) 31
- 30a. Tergum 5 without apical fasciae of white hairs; punctures of vertex coarse to very coarse (over 0.06 mm diameter), with variable interspaces up to one-half puncture diameter
..... *campanulae* (Robertson) 31
- b. Tergum 5 with apical fasciae of white hairs; punctures of vertex moderate (less than 0.055 mm diameter), largely contiguous
..... *angulatum* (Cockerell) 32
- 31a. Dorsal pubescence of metasoma whitish, discs of terga 4 and 5 with simple, blackish hairs only 32
- b. Dorsal pubescence of metasoma yellowish to fulvous, discs of terga 4 and 5 with abundant short, appressed, plumose, fulvous hairs
..... *otomita* (Cresson) 33
- 32a. Flocculent hairs present at side of pronotal collar and in a more or less defined band across front of mesoscutum; tergum 6 brown pubescent and scopa of sternum 6 largely brownish
..... *exilis* (Cresson) 34
- b. Flocculent hairs absent, or at least not conspicuously present, laterad on pronotal collar and none across front of mesoscutum; tergum 6 mostly whitish pubescent and scopa of sternum 6 mostly or entirely yellowish
..... *quadridentata* (Mitchell) 35
- 33a. Upper face of mandible strongly protuberant at base (Figs. 61, 62, 65, 66, 69, 70) 34
- b. Upper face of mandible without prominent basal protuberance (Figs. 55, 57, 71) or with low, rounded bulge (Fig. 72) 36
- 34a. Clypeus with prominent lateral and less prominent median lobe (Figs. 65, 69); labrum without preapical elevation; inner margin of mandible not excavated below basal protuberance 35
- b. Clypeus with sublateral processes that are protuberant at right angles to face (Fig. 60); labrum, in profile, strongly elevated near apex; mandible with deep, pit-like excavation on inner surface below basal protuberance
..... *davidsoni* (Cockerell) 36
- 35a. Median clypeal lobe very broad and weakly convex (Fig. 65); mesoscutum with complete anterior fasciae of dense, white tomentum
..... *lobatifrons* (Cockerell) 37
- b. Median lobe of clypeus narrow and strongly protuberant (Fig. 69); mesoscutum with narrow anterolateral patches of tomentum
..... *occidentalis* (W. Fox) 38
- 36a. Basal face of tergum 6, in profile, evenly sloping to base of apical lip; clypeus usually convex, apical margin various, but not as below
..... *adelphodonta* (Cockerell) 39
- b. Basal face of tergum 6, abruptly declivitous apicad, forming false preapical groove; clypeus flat, produced in middle, margin of lobe straight and with small apicolateral tubercles (Fig. 55)
..... *adelphodonta* (Cockerell) 39
- 37a. Clypeal margin deeply emarginate between two prominent lobes (Figs. 56, 57) 38
- b. Clypeal configuration various, but margin not deeply emarginate between prominent lobes
..... *odontostoma* (Cockerell) 39
- 38a. Lobes of clypeus lateral, broadly convex along apical margins (Fig. 57); clypeus flat in middle, supraclypeal area and base of clypeus protuberant in profile *browni* (Mitchell) 40
- b. Lobes of clypeal margin submedian, narrow, acute (Fig. 56); middle of clypeus elevated, supraclypeal area and base of clypeus not protuberant in profile
..... *odontostoma* (Cockerell) 40
- 39a. Mandible short and broad, with four or five teeth, length of apical (dentate) margin much more than one-half length of lower margin (Fig. 71) 40
- b. Mandible long and slender, with three or four teeth, length of apical (dentate) margin always less than one-half and usually less than one-third length of lower margin (Figs. 54, 67)
..... *prosopidis* (Cockerell) 41
- 40a. Clypeal margin transverse or slightly produced and irregular or weakly denticulate; mandible with four teeth 41
- b. Clypeus prominently trilobate (Fig. 71); mandible with five teeth *prosopidis* (Cockerell) 41
- 41a. Clypeus convex, margin produced in middle, with prominent median denticle, irregularly eroded laterad; disc of clypeus with sparse, plumose, white hairs and scattered simple, black hairs 42
- b. Clypeus flattened, margin transverse and irregular; disc of clypeus with sparse, simple, yellowish hairs and a few white, plumose hairs at side
..... *georgica* (Cresson) 43
- 42a. Fifth tergum with at least sparse, short, appressed, plumose white hairs along apical margin similar to those on preceding segment, and often with similar hairs on middle of disc; face and vertex with conspicuous, long, blackish hairs
..... *abacula* (Cresson) 44
- b. Fifth tergum without appressed, plumose, white hairs along apical margin or on disc; face with blackish hairs limited to clypeus (usually inconspicuous) and vertex
..... *alucaba*, new species 45
- 43a. Middle of clypeus strongly protuberant above and between pair of submedian tubercles on margin (Figs. 54, 67) 44
- b. Clypeal configuration not as above, always without developed submedian tubercles on margin (Figs. 59, 73) 45
- 44a. Legs mostly dark brownish, tarsi lighter; sub-

median tooth on upper margin of mandible inconspicuous (sometimes absent), margin between it and innermost apical tooth shallowly concave and about as long as apical width of mandibles (Fig. 22) *texensis* (Mitchell)

- b. Legs ferruginous (rarely brownish); submedian tooth on upper margin of mandible prominent, margin between it and innermost apical tooth deeply concave and much shorter than apical width of mandible (Fig. 21)

- 45a. Hypostomal area without cariniform ridge laterad of, and parallel with, hypostomal carina; margins of labrum not evenly convergent apicad; clypeal disc without lateral corni (Figs. 59, 63) 46
- b. Hypostomal area with cariniform ridge laterad of, and parallel with, hypostomal carina; margins of labrum evenly convergent apicad; clypeal disc with lateral corni (Fig. 73)
- 46a. Upper and lower portions of clypeus meeting through a broad, transverse arch (Fig. 63), apical margin simple, without lateral lobes. . 47
- b. Clypeus not transversely bowed or arched, median lobe strongly protuberant over basal one-half, lower facet oblique (Fig. 60)
- 47a. Transverse bow of clypeus broadly interrupted across middle; punctures of vertex very coarse (0.07–0.09 mm), with some interspaces up to one-half puncture diameter
- b. Transverse bow of clypeus continuous across middle (Fig. 63); punctures of vertex moderate (0.03–0.04 mm), uniformly subcontiguous

Group I (*exilis* Group)

GROUP CHARACTERS. Male mandible with ventral triangular process and hypostomal acetabulum present; male protarsal segments concave and glabrous on inner surface; female mandible short and broad, with four or five apical teeth; female clypeal disc unmodified, apical margin more or less denticulate or tuberculate; female tergum 6 with distinct preapical groove.

INCLUDED SPECIES. *Chalicodoma angularum* (Cockerell), *C. asymmetrica*, n. sp., *C. campanulae* (Robertson), *C. exilis* (Cresson), *C. otomita* (Cresson), *C. quadridentata* (Mitchell), *C. reflexa*, n. sp., and *C. subexilis* (Cockerell).

This is the largest species group and the most widely distributed, with species represented from southern Canada to northern South America, but absent from the Hot Desert habitats of western North America. In western North America, species are usually found in montane and submontane areas but intrude into lowland habitats, such as valley floors and prairies, across northern regions. Most

species fly during summer months, and nest-provisioning females appear to be highly polylectic.

Chalicodoma (*Chelostomoides*) *angularum* (Cockerell)

Figure 51

Megachile angularum Cockerell, 1902:70; ♀.

Megachile (*Chelostomoides*) *angularum*: Mitchell, 1937:384, 385, 386–388; ♀♂. Mitchell, 1956:131, 136, 137; ♀♂.

This is one of the most common and generally distributed of the western *Chelostomoides*, ranging from British Columbia to southern California, eastward to Nevada, Arizona, and New Mexico. The range of this species also includes UNITED STATES, IDAHO: 2 ♂♂, Wood River, 1 mi NE Gooding Co., 6-7-1980 (M. Wasbauer; Cdfa); and MEXICO, BAJA CALIFORNIA: 1 ♂, “76.5 km on road to Sierra San Pedro Martir National Park,” 20 July 1977 (D. Weismann and C. Mullinex; CAS).

The parasitoid *Sapyga angustata* (Cresson) [Sapygidae] has been reared from nests of *C. angularum* in California (Linsley, 1944).

This common, widespread species visits a wide variety of flowers, presumably for both pollen and nectar. The following are the known floral records. APIACEAE: *Perideridia gairdneri*. ASTERACEAE: *Achillea millefolium*, *Aster adscendens*, *A. canescens*, *Calycadenia multiglandulosa*, *Centaurea solstitialis*, *Chrysopsis fastigiata*, *C. fremontii*, *C. villosa*, *Chrysothamnus* sp., *C. nauseosus*, *Cirsium* sp., *C. vulgare*, *Corethrogyne filaginifolia*, *Encelia farinosa*, *Erigeron* sp., *Franseria* sp., *Grindelia camporum*, *G. hallii*, *Haplopappus arborescens*, *Helianthus gracilentus*, *Lessingia leptoclada*, *Rudbeckia californica*, *Solidago californica*, *S. confinis*, *S. occidentalis*. BORAGINACEAE: *Cryptantha ambigua*, *C. denticulata*, *C. intermedia*, *Heliotropium curassavicum*. BRASSICACEAE: *Brassica* sp., *B. incana*, *Erysimum asperum*. CAPRIFOLIACEAE: *Lonicera interrupta*, *Symphoricarpos* sp. FABACEAE: *Amorpha californica*, *Astragalus douglasii*, *A. parishii*, *Cercidium floridum*, *Glycyrrhiza lepidota*, *Lathyrus* sp., *Lotus* spp. (13), *Lupinus austromontanus*, *L. longipes*, *Medicago sativa*, *Melilotus alba*, *M. officinalis*, *Trifolium variegatum*. FUMARIACEAE: *Dicentra chrysantha*. GENTIANACEAE: *Suertia parryi*. GERANIACEAE: *Geranium richardsonii*. HYDROPHYLLACEAE: *Eriodictyon* sp., *Phacelia* sp., *P. heterophylla*, *P. imbricata*, *P. ramosissima*. LAMIACEAE: *Marrubium vulgare*, *Monardella lanceolata*, *M. linoides*, *M. stricta*, *Salvia apiana*, *S. pachyphylla*, *Stachys albens*, *S. pycnantha*, *S. rigida*, *Trichostema larum*, *T. parishii*. LOASACEAE: *Mentzelia laevicaulis*. ONAGRACEAE: *Clarkia unguiculata*, *Epilobium angustifolium*. POLEMONIACEAE: *Gilia capitata*. POLYGONACEAE: *Eriogonum* spp. (5). RANUNCULACEAE: *Rhamnus* sp., *R. californicus*. ROSACEAE:

Harkelia bolanderi var. *parryi*, *Potentilla glandulosa*. SAXIFRAGACEAE: *Ribes leucodermis*. SCROPHULARIACEAE: *Collinsia tinctoria*, *Cordylanthus* spp. (6), *Keckiella* spp. (4), *Penstemon* spp. (5). VERBENACEAE: *Verbena californica*, *V. prostrata*, *Vitex* sp.

***Chalicodoma (Chelostomoides)*
asymmetrica, new species**

Figures 43–46

DIAGNOSIS

Male separable from all others possessing a ventral mandibular process, except *C. subexilis*, by the lack of a mastigion on the probasitarsus; differs from *C. subexilis* in having the ventral surface of the procoxa densely covered with abundant plumose white hairs. Female unknown.

DESCRIPTION

MALE. Measurements (mm): Holotype: head width (HW) 2.75; HL 2.23; WL 5.3; total length (TL) 8.1. Paratypes: HW 2.68–2.77; HL 2.18–2.27; WL 5.1–5.2; TL 7.8–8.1.

Head about 1.2 times as broad as long; inner eye margins weakly convergent below, upper interorbital distance about 1.1 times lower interorbital distance; in frontal view, preoccipital margin distinctly elevated above eyes and ocelli. Mandible with prominent ventral process; apex tridentate, inner tooth large, acute. Labrum normal, apex truncate, margins parallel. Clypeus weakly convex; apical margin broadly and weakly incurved, with a small median and a pair of larger submedian tubercles; disc punctures moderate, subcontiguous to contiguous, interspaces shiny; without basal or median impunctate areas. Superclypeal area similar but punctures slightly finer and largely contiguous, hence appearing duller; punctures about as coarse as those of clypeus on vertex and preocciput, becoming subcontiguous, interspaces very weakly tessellate and moderately shiny; gena about half as wide as eye in profile, shiny between subcontiguous moderate punctures that become slightly finer and contiguous near eye margin. Pedicel about twice as long as first flagellar segment, latter broader than long; second flagellar segment about three times longer than first. Interocellar and ocellocular distances subequal and slightly greater than ocelloccipital distance.

Mesoscutum finely tessellate and slightly shiny between subcontiguous to dense moderate punctures; scutellum similar but slightly shinier, punctures contiguous to subcontiguous; metanotum tessellate and slightly shiny between irregularly spaced minute to fine punctures; mesepisternum and metepisternum slightly shiny, punctures moderate and mostly contiguous to subcontiguous, but with irregular interspaces up to a puncture diameter, especially ventrad; side of propodeum slightly shiny between mostly subcontiguous moderate punctures.

Anterior face of procoxa with numerous, long, erect, plumose, white hairs; apical process bluntly triangular, about as long as broad at base. Probasitarsus without mastigion and about three times longer than broad; second segment of protarsus about one-third shorter and about as broad as probasitarsus, asymmetrical; third segment about one-third as long as probasitarsus and narrower than second; all three segments slightly concave on inner face, smooth, shiny, and bare; last protarsal segment distinctly shorter than probasitarsus.

First metasomal tergum shiny between subcontiguous moderate punctures; terga 2–4 shiny, punctures moderate, very variably spaced, from subcontiguous to close; tergum 5 similar but subcontiguously punctate; tergum 6 dull, contiguously finely punctate, carina bilobate, apical margin with low, oblique lateral teeth and broad, lobe-like median teeth. Exposed sterna shiny between subcontiguous moderate punctures.

Hidden sterna and genitalia as in Figures 43–46.

Pilosity mostly white and conspicuously plumose; sparse on clypeus except along apical margin; abundant but not wholly concealing surface on rest of face, becoming sparse on vertex-preocciput; pronotum with flocculent hairs only along margin of posterior lobe; mesoscutum without patches or band of flocculent hairs; tergum 1 with flocculent patch on each side of apical margin; terga 2–6 with basal fasciae of short, appressed, plumose hairs, weakest on 2, strongest on 5; disc of terga 5 and 6 uniformly covered with short, plumose, appressed hairs, entirely white on 5 and along midline of 6, yellowish brown on remainder of 6; sterna 1–3 with long, appressed and decumbent, white, plumose hairs, discs of 1 and 2 largely bare, 3 mostly covered but with basolateral bare areas. Clypeus, vertex-preocciput, mesoscutum and scutellum with sparse long, erect, fuscous hairs.

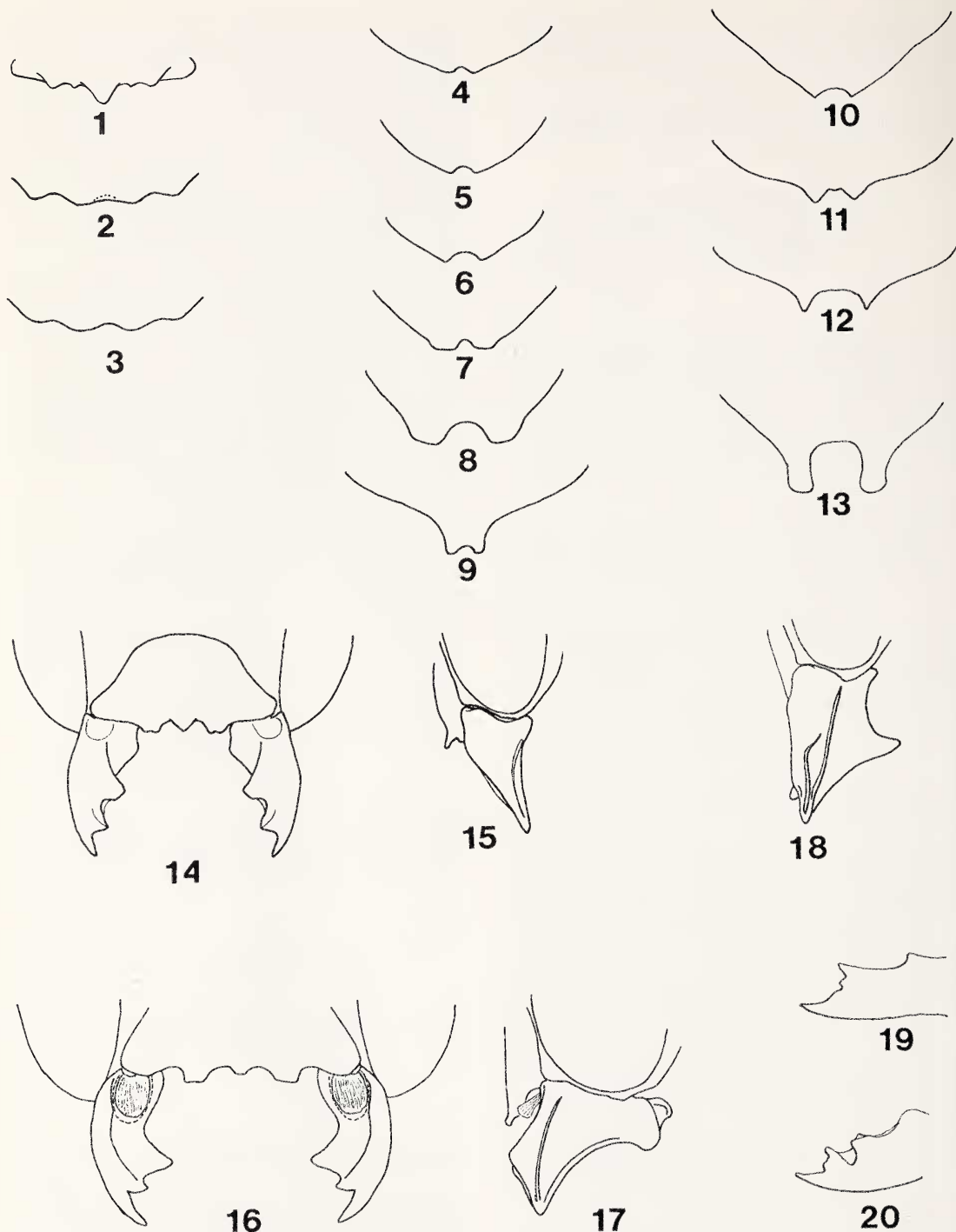
Color mostly blackish brown, becoming lighter on antenna, legs, and metasoma; at least tergum 6, and sometimes margin of tergum 5, somewhat ferruginous. Tegula dark brown. Wings clear, weakly brown, veins and stigma light brown.

TYPE MATERIAL

Holotype and three paratype males: 17 km W Tehuantepec, OAXACA, MEXICO, 8 Sept. 1965 (D.H. Janzen), on *Caesalpinia sclerocarpa* (FABACEAE). Paratypes: 13 ♂♂, Río Chamela, JALISCO, 15–24 Apr. 1986 (F.D. Parker); 1 ♂, Puerto Vallarta, JALISCO, 25 Jan. 1984 (G.E. Bohart); 2 ♂♂, Kabah, 25 km SW Ticul, YUCATAN, 14 Feb. 1987 (C.D.) Michener; 3 ♂♂, Yodzonot, YUCATAN, 16 Feb. 1987 (C.D. Michener). Holotype in UKAN; paratypes in LACM, UKAN, and BBSL.

ETYMOLOGY

From Greek, *a-* (not) + *symmetros* (equal), in allusion to the shapes of the protarsal segments.

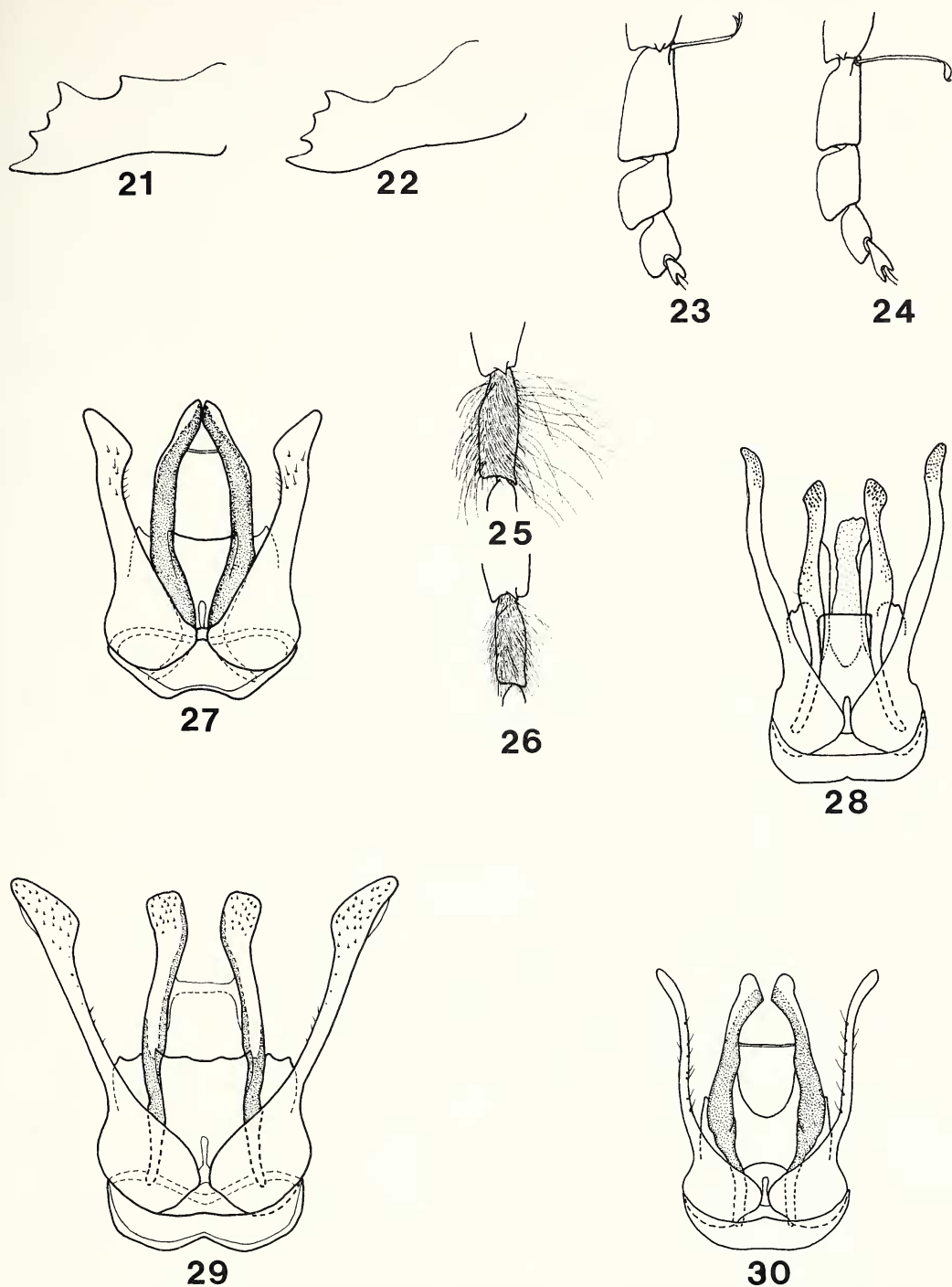


Figures 1-20. *Chalicodoma* spp., males. 1-3, clypeal margin of *C. alucaba* (1), *C. browni* (2), and *C. odontostoma* (3). 4-13, outline of carina of metasomal tergum 6 of *C. alucaba* (4), *C. browni* (5), *C. odontostoma* (6), *C. davidsoni* (7), *C. reflexa* (8), *C. lobatifrons* (9), *C. texensis* (10), *C. adelphodonta* (11), *C. discorbina* (12), and *C. spinotulata* (13). 14-17, frontal and lateral views of clypeus and mandible of *C. abacula* (14, 15) and *C. spinotulata* (16, 17). 18, lateral view of clypeus and mandible of *C. reflexa*. 19, 20, mandible of *C. axyx* (19) and *C. alucaba* (20).

DISCUSSION

In addition to the above types, one additional male has been seen: 10.7 mi N Ciudad del Valle, 950 ft. elev., San Luis Potosí, MEXICO, 2 Sept. 1962 (Uni-

versity of Kansas Mexico Expedition; UKAN). It is smaller than any in the type series (HW 2.59, HL 2.05, WL 5.1, TL 7.5) but is otherwise very similar to the specimens from Oaxaca, although the disc of sternum 3 is largely bare.

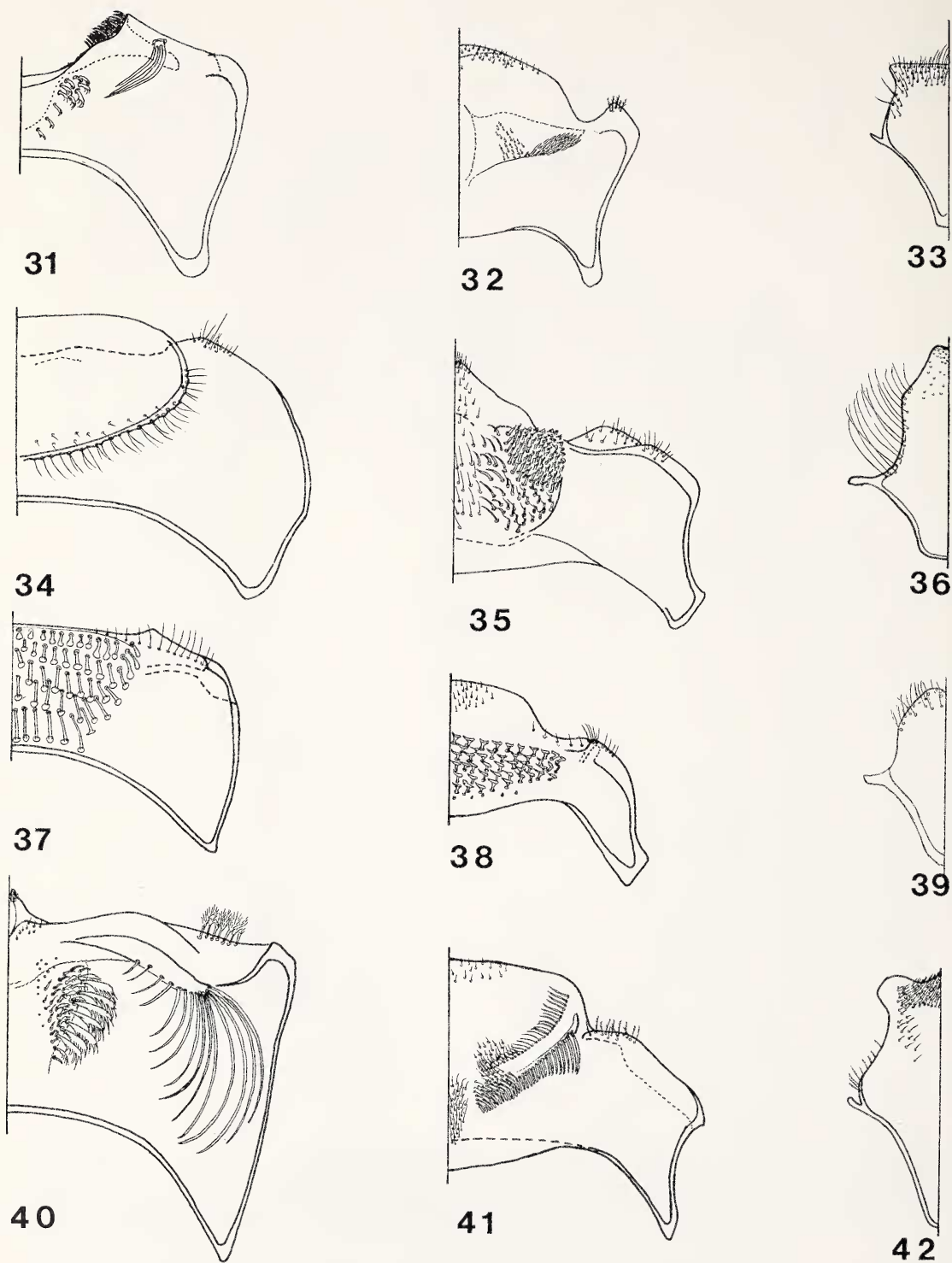


Figures 21–30. *Chalicodoma* spp. 21, 22, mandible of female of *C. axyx* (21) and *C. texensis* (22). 23, 24, protarsus of male of *C. exilis* (23) and *C. quadridentata* (24). 25, 26, mesobasitarsus of male of *C. axyx* (25) and *C. texensis* (26). 27–30, male genitalia, dorsal view, of *C. axyx* (27), *C. quadridentata* (28), *C. reflexa* (29), and *C. alucaba* (30).

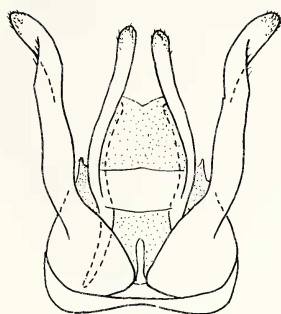
Because the probasitarsus lacks a mastigion, this species is readily separable from males of other species that possess a ventral mandibular process, except that of the similar *C. subexilis*. Males of *C. subexilis* have the anterior face of the procoxa covered with short, yellowish, simple bristles, rather

than long, erect, plumose, white hairs. In addition, males of *C. subexilis* lack fuscous hairs on the clypeus, the disc of tergum 5 is without appressed, plumose hairs, and the first flagellar segment is about as long as broad ad subequal to the pedicel in length.

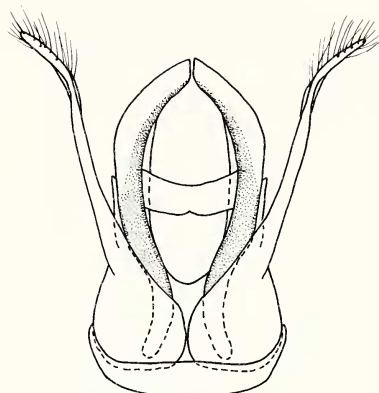
A female collected by F.D. Parker at Rio Cha-



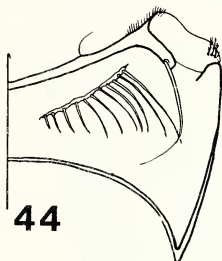
Figures 31-42. *Chalicodoma* spp., male metasomal sterna 5, 6, and 8, respectively, of *C. quadridentata* (31-33), *C. axyx* (34-36), *C. alucaba* (37-39), and *C. reflexa* (40-42).



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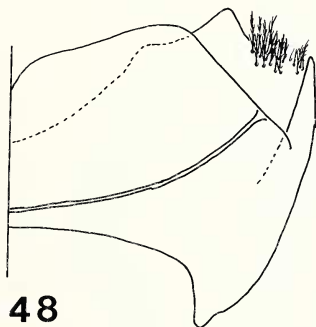
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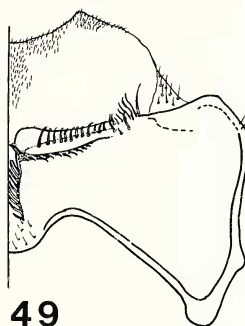
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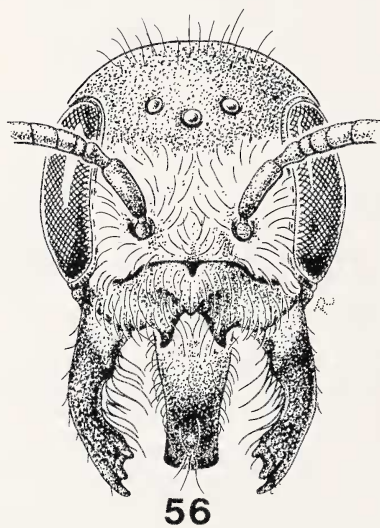
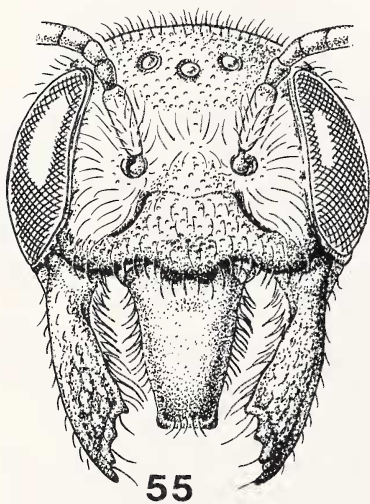
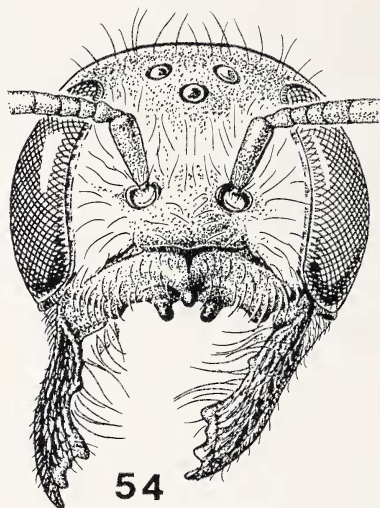
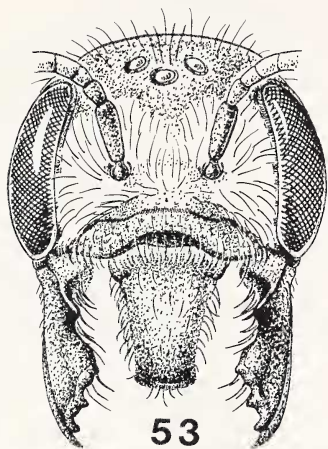
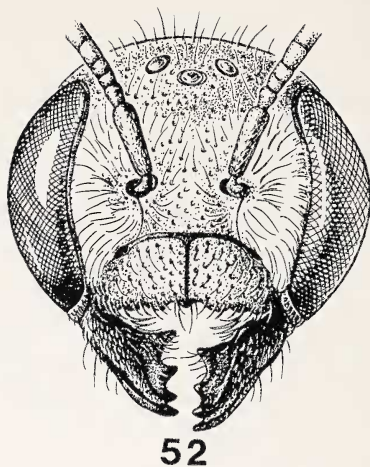
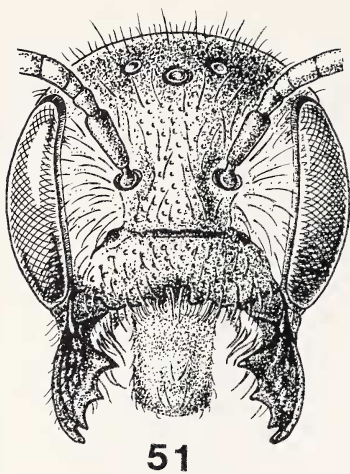
Figures 43-50. *Chalicodoma* spp., males, genitalia (dorsal view) and metasomal sterna 5, 6, and 8, respectively, of *C. asymmetrica* (43-46) and *C. spinotulata* (47-50).

mela probably belongs to this species. Morphologically it is hardly separable from those of *C. quadridentata*, to which it will go in the above key. It is smaller than females of *C. quadridentata*, with the head width only about 2.5 mm, whereas that of *C. quadridentata* exceeds 3.5 mm; metasomal tergum 5 lacks an apical, pubescent band and the discs of 5 and 6 have conspicuous, short, subappressed to appressed, yellowish pubescence.

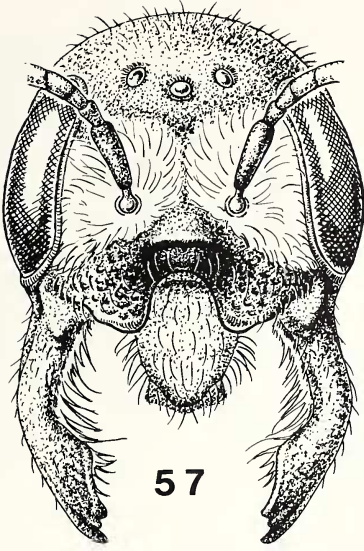
Chalicodoma (*Chelostomoides*) *campanulae* (Robertson)

Oligotropus campanulae Robertson, 1903:171; ♀♂.
Oligotropus wilmingtوني Mitchell, 1924:156; ♀♂.
NEW SYNONYMY.

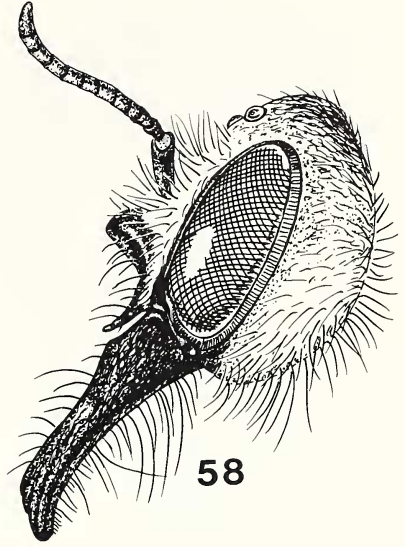
Megachile (*Chelostomoides*) *campanulae* var. *wilmingtوني*: Mitchell, 1937: 391; ♀.



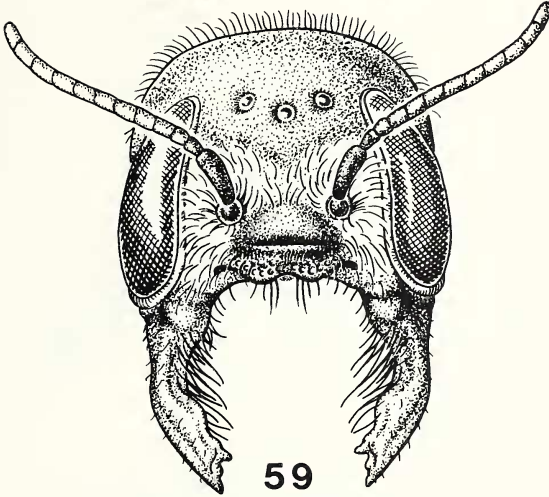
Figures 51-56. *Chalicodoma* spp., frontal view of head of female of *C. angelarum* (51), *C. exilis* (52), *C. manni* (53), *C. texensis* (54), *C. adelphodonta* (55), and *C. odontostoma* (56). (Figures by Tina Ross.)



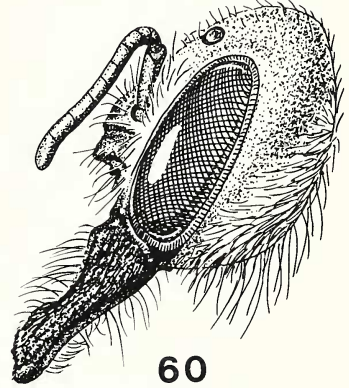
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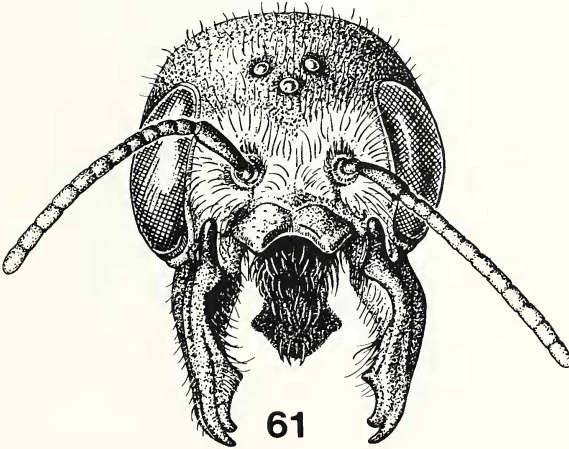
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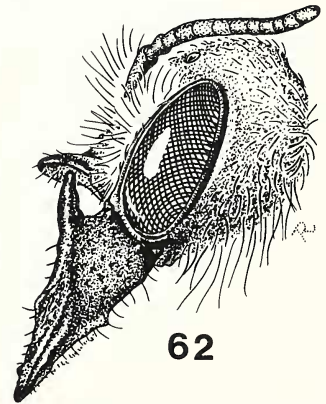
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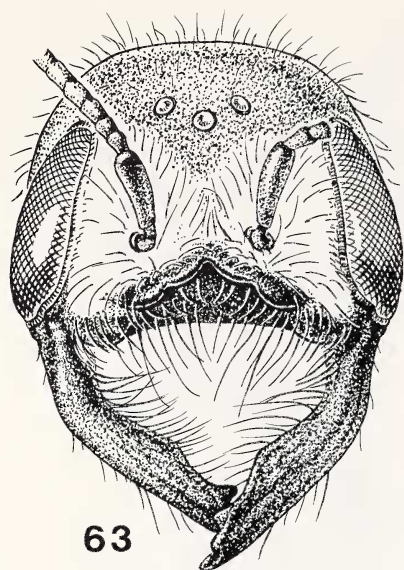


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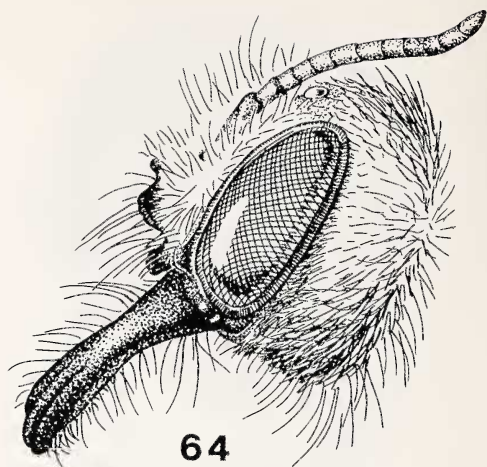


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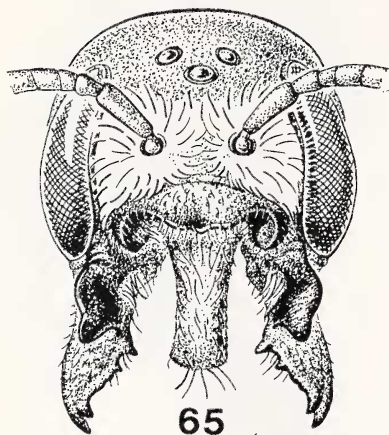
Figures 57–62. *Chalicodoma* spp., frontal and lateral view of head of female of *C. browni* (57, 58), *C. chilopsidis* (59, 60), and *C. davidsoni* (61, 62). (Figures by Tina Ross.)



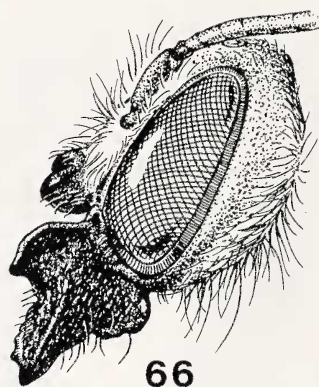
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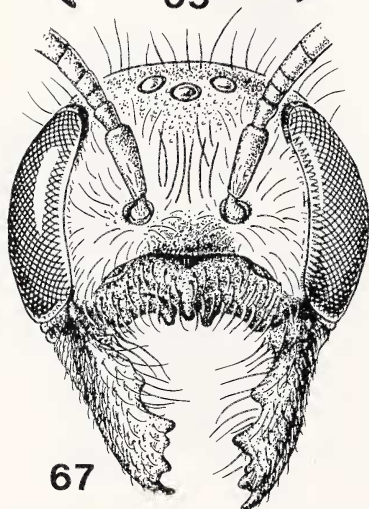
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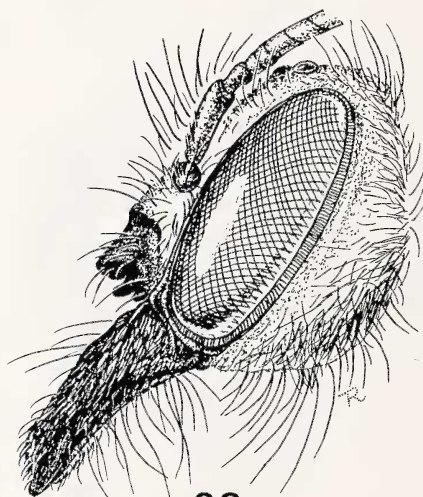
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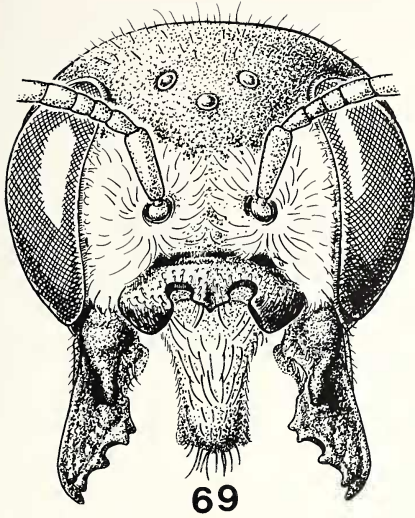


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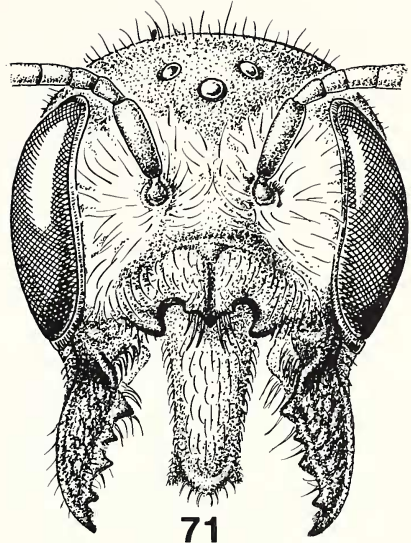


68

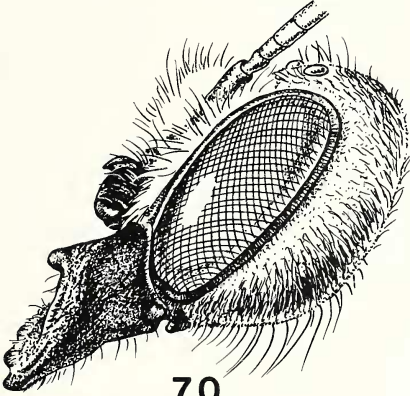
Figures 63–68. *Chalicodoma* spp., frontal and lateral view of head of female of *C. discorhina* (63, 64), *C. lobatifrons* (65, 66), and *C. axyx* (67, 68). (Figures by Tina Ross.)



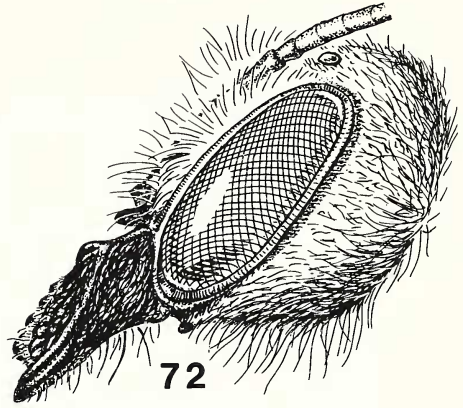
69



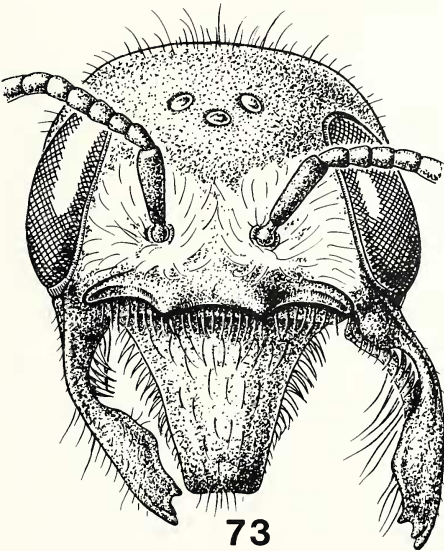
71



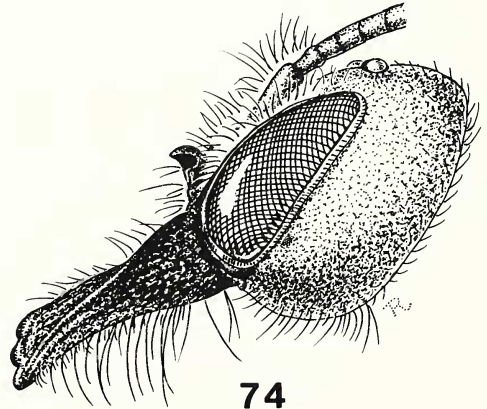
70



72

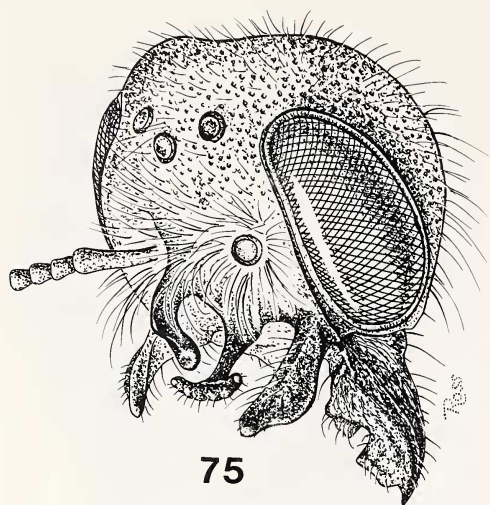


73

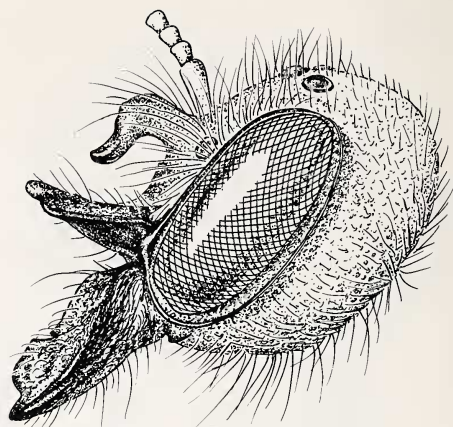


74

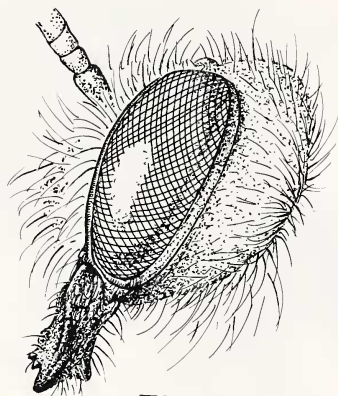
Figures 69-74. *Chalicodoma* spp., frontal and lateral view of head of female of *C. occidentalis* (69, 70), *C. prosopidis* (71, 72), and *C. eclectica* (73, 74). (Figures by Tina Ross.)



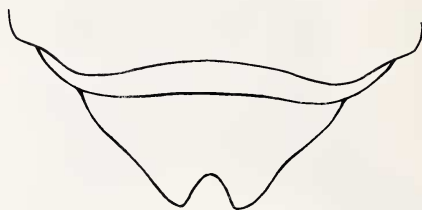
75



76



77



78

Figures 75–78. *Chalicodoma armaticeps*. 75, 76, lateral a. . oblique views of head of female; 77, lateral view of male head; and 78, outline of transverse carina of male metasomal tergum 6. (Figures by Tina Ross.)

The variety or subspecies *wilmingtoni* differs from the typical form in possessing darker wings and black pubescence on the sixth sternum of the female. The range of the variant lies wholly within that of the nominate form, and many specimens of intermediate character have been seen. Variation seems to be clinal, with specimens becoming progressively darker in coastal areas of the Carolinas, Georgia, and Florida. Under the circumstances, there is no justification for formally separating the variant phenotype.

The range of *C. campanulae* extends from Quebec and Massachusetts south to Florida, and into the midwestern United States, from Minnesota to central Texas. The westernmost records are from COLORADO: 1 ♀, 5 mi S Coal Dale, 7300 ft elev., Fremont Co., 13 Aug. 1969 (C.D. Michener; UKAN); 2 ♂♂, 2 mi S Coal Dale, 7500 ft elev., Fremont Co., 10 Aug. 1964 (C.D. Michener; UKAN), on *Cam-*

panula. MONTANA: 1 ♀, near Florence, Ravalli Co., 24 June 1980 (D. Yanega; UKAN).

Nests are constructed in borings in wood; the cleptoparasitic bee, *Coelioxys modesta* F. Smith, has been reared from nests of *C. campanulae* (Krombein, 1967).

Known floral records for *C. campanulae* are as follows. ASCLEPIADACEAE: *Asclepias* sp. ASTERACEAE: *Helianthus* sp., *Rudbeckia* sp., *Solidago* sp. CAMPANULACEAE: *Campanula* sp., *C. americana*, *C. campanulae*, *C. rotundifolia*. CAPRIFOLIACEAE: *Symphoricarpos* sp. FABACEAE: *Baptisia tinctoria*, *Desmodium canadense*, *Galactia* sp., *Melilotus* sp., *Phaseolus* sp., *Psoralea* sp. LAMIACEAE: *Monarda* sp., *Nepeta* sp., *Pycnanthemum* sp. LOBELIACEAE: *Lobelia* sp. LYTHRACEAE: *Lythrum* sp. MALVACEAE: *Malva sylvestris*. ONAGRACEAE: *Epilobium angustifolium*, *Oenothera* sp. PONTEDERIACEAE: *Ponte-*

deria sp. SCROPHULARIACEAE: *Veronica* sp.
VERBENACEAE: *Verbena* sp.

Chalicodoma (*Chelostomoides*)
exilis (Cresson)

Figures 23, 52

Megachile exilis Cresson, 1872:265; ♂.
Megachile studiosa Cresson, 1872:269; ♀.
Megachile (*Chelostomoides*) *exilis* var. *parexilis*
Mitchell, 1937:393–394; ♂. NEW SYNONYMY.

The eastern form, variety *parexilis*, was based on male specimens that differed slightly from the nominate, western form in having the third protarsal segment nearly as wide as the second. No female differences were noted. Variation within populations is sufficiently broad that many western males may be assigned to the eastern variant. The eastern form does appear to be generally more consistent, but not wholly so. I see no utility in recognizing those males with a broader third tarsal segment as a separate subspecies.

This species ranges from the mountains of southern Arizona east to the Atlantic coastal states, from Virginia and Maryland south to Florida. The following specimens have been seen from MEXICO. BAJA CALIFORNIA SUR: 1 ♂, La Laguna, 1675–1725 m elev., Sierra de La Laguna, 28 Aug.–1 Sept. 1977 (R.R. Snelling; LACM), on *Gnaphalium* sp. HIDALGO: 1 ♂, 9 mi S Zimapán, 6100 ft elev., 23 June 1953 (University of Kansas Mexican Expedition; UKAN). MORELOS: 1 ♀, 7 mi NE Yautepec, 4000 ft elev., 18 Aug. 1962 (University of Kansas Mexican Expedition; UKAN); 1 ♀, 7.3 mi S Yautepec, 3000 ft elev., 16 Aug. 1962 (Ordway and Naumann; UKAN); 1 ♀, 0.6 km S Teacalco, 1020 m elev., 16 Sept. 1976 (C.D. George and R.R. Snelling; LACM), on *Crotalaria incana*. SAN LUIS POTOSÍ: 1 ♀, 3.4 mi NE El Naranjo, 800 ft elev., 5 Sept. 1962 (University of Kansas Mexican Expedition; UKAN). SONORA: 1 ♀, Alamos, 7 Sept. 1970 (G.E. and R.M. Bohart; BBSL). TAMAULIPAS: 1 ♂, 6.2 mi S San Fernando, 9 July 1966 (University of Kansas Mexican Expedition; UKAN); 1 ♂, 80 km S Ciudad Victoria, 23 June 1981 (B. Miller, C. Porter, and L. Stange; FSCA); 1 ♀, Llera Mesa, 1800 ft elev., 7 June 1961 (University of Kansas Mexican Expedition; UKAN).

This wide-ranging species flies mainly during the summer months, with most records during June, July, and August. There are, however, records as early as March and as late as October.

A wide variety of flowers is visited for nectar and/or pollen, including 32 genera in 13 families, as follows. ANACARDIACEAE: *Rhus* sp. ASCLEPIADACEAE: *Asclepias* sp., ASTERACEAE: *Baccharis* sp., *Bidens pilosa*, *Coreopsis* sp., *Erigeron* sp., *Gnaphalium* sp. BIGNONIACEAE: *Chilopsis linearis*. BRASSICACEAE: *Sisymbrium linearifolium*. CELASTRACEAE: *Ilex* sp. ERICACEAE: *Vaccinium* sp. FABACEAE: *Baptisia tinctoria*, *Cracca*

edwardsii, *Crotalaria* sp., *C. incana*, *Dalea* sp., *Galactia* sp., *Lespedeza repens*, *Lupinus* sp., *L. texensis*, *Melilotus* sp., *M. officinalis*, *Parkinsonia aculeata*, *Phaseolus* sp., *P. limensis*, *Sesbania sesbans*, *Tephrosia virginiana*, *Trifolium* sp., *Vicia* sp. HYDROPHYLLACEAE: *Hydrolea* sp. LAMIACEAE: *Mentha* sp., *Monarda* sp. ONAGRACEAE: *Oenothera* sp. POLYGALACEAE: *Polygala* sp. RHAMNACEAE: *Ceanothus* sp., *Condalia* sp.

Chalicodoma (*Chelostomoides*)
otomita (Cresson)

Megachile otomita Cresson, 1878:123; ♂. Mitchell, 1930:176.
Megachile squamosa Friese, 1916:340–341; ♀ ♂.
Megachile knabi Cockerell, 1919:215; ♂.
Megachile (*Chelostomoides*) *otomita*: Mitchell, 1930:158, 170, 176. Mitchell, 1956:135, 138.

Friese (1916) described *M. squamosa* from females from San José, Costa Rica, and a male from Popayan, Colombia. Cockerell's *M. knabi* was described from Cordoba, Mexico. Both names were correctly recognized as synonyms of *M. otomita* by Mitchell (1930), who recorded additional specimens from San José and "Mount Redonda," Costa Rica. Cockerell (1949) recorded specimens of both sexes from Zamorano, Honduras.

The following data will amplify our knowledge of the distribution of *C. otomita*. MEXICO, CHIAPAS: 1 ♂, 28 mi W Cintalapa, 9 Apr. 1962 (F.D. Parker; BBSL); 2 ♂♂, El Sumidero, 17 Sept. 1975 (J.L. Neff; NEFF), on composite. JALISCO: 2 ♀♀, 1 ♂, Laguna Chapala, 21 Aug. 1957 (A.P. Yerrington; LACM); 1 ♂, 24.1 mi NW Tequila, 11 Aug. 1963 (G.W. Byers; UKAN). MORELOS: 1 ♀, 6.7 mi W. Yautepec, 29 July 1963 (M. Naumann and A. Wille; UKAN); 1 ♂, 6 mi SW Jonocatepec, 3700 ft elev., 18 Aug. 1962 (University of Kansas Mexican Expedition; UKAN); OAXACA: 1 ♂, 2 mi NW Jamiltepec, 12 Oct. 1975 (J.L. Neff; NEFF), on *Salvia*; 1 ♂, 3.4 mi S Jacatepec, 2400 ft elev., 16 July 1973 (R.R. Snelling and T. W. Taylor; LACM); 1 ♂, Oaxaca, 5000–5580 ft elev., 2 May 1965 (H.V. Weems; FSCA), on *Aster*; 1 ♀, 4 mi W Zanatepec, 200 m, 15 Sept. 1975 (J.L. Neff; NEFF), on composite; 1 ♂, 23 mi S Matias Romero, 22 Apr. 1962 (F.D. Parker; BBSL). QUINTANA ROO: 2 ♀♀, X-can, 8 May 1963 (E.C. Welling; LACM). SAN LUIS POTOSÍ: 1 ♀, 9 mi S Ciudad del Valle, 600 ft elev., 2 Sept. 1962 (University of Kansas Mexican Expedition; UKAN); 1 ♀, 10.7 mi N Ciudad del Valle, 950 ft elev., 2 Sept. 1962 (University of Kansas Mexican Expedition; UKAN); 2 ♀♀, 9 ♂♂, El Salto, 1700 ft elev., 15 July 1963 (University of Kansas Mexican Expedition; UKAN); 3 ♂♂, same locality and date (G.W. Byers; UKAN); 1 ♂, El Salto, Río Salto, 27 July 1969 (G. Gordh and D. Kamm; UKAN); 2 ♂♂, 7 mi NW Tamazunchale, 15 July 1968 (M.G. Naumann; UKAN). TAMAULIPAS: 1 ♀, 1 ♂, 17 mi S Llera, 16 June 1953 (University of

Kansas Mexican Expedition; UKAN); 1 ♂, 6.6 mi W Antiqua Morelos, 400 ft elev., 3 Sept. 1962 (Ordway and Naumann; UKAN). VERA CRUZ: 1 ♂, Río Atoyac, 5 mi NW Potrero, 15 July 1973 (R.R. Snelling and T. W. Taylor; LACM); 1 ♀, 9 mi N Tempoal, 6 June 1965 (Burke, Meyer, Schaffner; TAMU). YUCATAN: 7 ♀♀, 3 ♂♂, Yodronot, 16 Feb. 1987 (C.D. Michener; UKAN); 2 ♂♂, Uxmal ruins, 16 km SW Muna, 14 Feb. 1987 (C.D. Michener; UKAN). BELIZE, COROZA: 2 ♀♀, 15 mi S Santa Elena, 1 July 1966 (University of Kansas Mexican Expedition; UKAN). GUATEMALA: 1 ♀, 6.3 mi NE Esquintla, 30 July 1966 (University of Kansas Mexican Expedition; UKAN). COSTA RICA, CARTAGO: 1 ♀, Turrialba, 8 May 1948 (F. Shradler; UKAN). GUANACASTE: 6 ♀♀, Liberia, 15–16 Feb. 1972 (P.A. Opler, UCB), on *Andira inermis*; 19 ♀♀, 3 ♂♂, same locality and collector, 23–26 Feb. 1972, on *An. inermis*; 5 ♀♀, same locality and collector, 1 Mar. 1972, on *An. inermis*; 1 ♂, Finca La Pacifica, 4 mi NW Cañas, 19 May 1971 (P.A. Opler; UCB), on *Acacia tenuiflora*; 2 ♀♀, 2 ♂♂, Hacienda Comelco, 24 km NW Cañas, 6 Mar. 1972 (E.R. Heithaus; LACM), on *An. inermis*, 1045–1120 hr; 5 ♀♀, same locality and collector, 9 Mar. 1972, on *An. inermis*, 0745–0815 hr; 1 ♂, Hacienda Comelco, 8 km W Bagaces, 26 Jan. 1972 (P.A. Opler; UCB), on *Triplaris americana*; 1 ♂, same locality and collector, 29 Sept. 1973, on *Lotus*; 2 ♀♀, El Coco, 20 June 1963 (Kerfoot et al.; UKAN); 5 ♀♀, El Coco, 21 June 1963 (C.D. Michener; UKAN). SAN JOSE: 15 ♀♀, Santa Ana, 31 July 1963 (C.D. Michener and O'Conner; UKAN). COLOMBIA, ANTIOQUIA: 1 ♀, Río Porce, 1000 m elev., 2 Oct. 1976 (C.D. Michener; UKAN). VALLE: 1 ♀, 2 ♂♂, Loboguerrera, 740 m elev., 4 Feb. 1977 (M. Breed and C.D. Michener; UKAN); 1 ♂, Ginebra, 13–14 July 1979 (M.A. Tidwell; FSCA); 1 ♀, Central Hidroeléctrica de Anchicaya, 17 Mar. 1979 (J. Monsalve; FSCA); 2 ♀♀, 1 ♂, Atuncela, Nov. and Dec. 1974 (R.C. Wilkerson; FSCA); 16 ♀♀, 34 ♂♂, Finca San Luis, 1010 m elev., Municipio Candelaria, dates throughout 1975 (R.C. Wilkerson; FSCA), all from malaise trap.

The above records include floral genera representing four families. ASTERACEAE: *Aster* sp. FABACEAE: *Acacia tenuiflora*, *Andira inermis*, *Lotus* sp. LAMIACEAE: *Salvia* sp. POLYGONACEAE: *Triplaris americana*.

Chalicodoma (*Chelostomoides*) *quadridentata* (Mitchell)

Figures 24, 28, 30–32

Megachile quadridentata Mitchell, 1930:177–178; ♀.

This species was described from a single female from Guadalajara, Mexico, and was compared with *C. exilis* and superficially similar species. The type is now in the USNM, and I have examined it. There is no question but that it is very similar to *C. exilis*. Were the status of *C. quadridentata* to be deter-

mined from this one specimen, I would have declared it a synonym of *C. exilis*. The differences between the two are not impressive.

Numerous additional females, and associated males, are available. With these at hand, it is apparent that *C. quadridentata* should be treated as a discrete species that maintains its integrity in areas of sympatry with *C. exilis*. Females of *C. quadridentata* do not possess a cluster of flocculent, white hairs at the side of the pronotal collar, as do those of *C. exilis*. Some specimens of *C. exilis* from the southeastern United States are similar but do possess a thin band of flocculent hairs across the front of the mesoscutum. Such hairs are uniformly lacking in females of *C. quadridentata* that I have seen. In particular, there are no flocculent hairs in the vicinity of the notaulices.

The few females of *C. exilis* available from central Mexico are similar to those of *C. quadridentata*. Although flocculent hairs are present on the sides of the pronotal collar, they are less conspicuously plumose than those of females from the United States. Flocculent hairs are generally absent across the front of the mesoscutum, but some are present on the notaulices. In these *C. exilis* females, the sixth tergum is dark pubescent; most females of *C. quadridentata* have conspicuous, pale, plumose hairs, though some (including the type) are dark pubescent.

Structurally, there appear to be no obvious differences between females of these species. The sub-lateral tubercles of the clypeal margin tend to be less distinctly separate from one another in *C. quadridentata*, and the punctures of terga 3 and 4 are less dense and a little finer. But, each species is sufficiently variable that no consistent pattern is clear.

Although males are also clearly similar, the differences in the shape of the protarsal segments, especially the third, will easily separate *C. quadridentata* from *C. exilis*. The presence of conspicuous, short, flattened, plumose, pale hairs on the discs of the fifth and sixth terga is also characteristic of *C. quadridentata* males.

It is possible that the males here associated with *C. quadridentata* do not belong to this species, and that the following species, *C. reflexa*, is the opposite sex of *C. quadridentata*. However, the males here assumed to belong to *C. quadridentata* are much more similar to those of *C. exilis* than are those of *C. reflexa*. They are especially similar in characteristics of the procoxa, the protarsi, and the shape of the apical metasomal tergum. For these reasons, I have assumed these to be the males of *C. quadridentata*.

In addition to the type, I have seen the following material of *C. quadridentata*, all from MEXICO. GUERRERO: 1 ♀, 1 ♂, 5 mi S, 2.5 mi E Chilpancingo, 3800 ft elev., 5 Aug. 1962 (University of Kansas Mexican Expedition; UKAN); 1 ♂, 2 mi E Tixtla, 4925 ft elev., 8 Aug. 1962 (Ordway and Naumann; UKAN). JALISCO: 2 ♀♀, 1 ♂, 10 mi N

Guadalajara, 16 Oct. 1968 (G.E. Bohart; BBSL); 3 ♀♀, Lake Chapala, 21 Apr. 1957 (A.P. Yerington; LACM); 4 ♀♀, Puerto Vallarta, 25 Jan. 1984 (G.E. Bohart; BBSL); 1 ♀, El Tuito, 25 Sept. 1985 (Parker and Griswold; BBSL); 2 ♀♀, 54 km SE Puerto Vallarta, 29 Sept. 1985 (C.D. Michener; UKAN); 1 ♀, Tamatlan, 1 Oct. 1985 (T. Griswold; BBSL); 2 ♀♀, Chamela, 26–30 Sept. 1985 (F.D. Parker and T.L. Griswold; BBSL); 1 ♀, Río Chamela, 15–24 Apr. 1986 (F.D. Parker; BBSL). **MORELOS**: 1 ♂, Ignacio Bastida, 12 Sept. 1980 (Michener, R. Murillo, J.M. Labougle; UKAN). **OAXACA**: 1 ♀, 23 mi S Matias Romero, 200 ft elev., 25 June 1961 (University of Kansas Mexican Expedition; UKAN); 1 ♀, 10 mi SE Oaxaca, 5300 ft elev., 6 July 1953 (University of Kansas Mexican Expedition; UKAN); 5 ♀♀, 5 ♂♂, 5 mi NW Totolapan, 3800 ft elev., 6 July 1953 (University of Kansas Mexican Expedition; UKAN); 1 ♂, 3 mi SE Yanhuitlan, 17 Sept. 1974 (G.E. and R.M. Bohart; BBSL); 2 ♂♂, 2 mi Cuyeyepeji 3, Mar. 1972 (F. Parker and D. Miller; BBSL); 8 ♀♀, 17 km W Tehuantepec, 8 Sept. 1965 (D.H. Janzen; UKAN), on *Caesalpinia sclerocarpa*; 1 ♀, 35 mi W Tehuantepec, 15 Sept. 1974 (G. Bohart and W. Hansen; BBSL). **PUEBLA**: 20 ♀♀, 7 ♂♂, 3 mi NW Petlalcingo, 4 Mar. 1972 (F. Parker and D. Miller; BBSL); 5 ♂♂, same locality, 6 Aug. 1969 (University of Kansas Mexican Expedition; UKAN); 1 ♂, 9 mi W Izucar de Matamoros, 3 Sept. 1974 (W. Hanson and G. Bohart; BBSL); 1 ♀, 3 mi S Zapotitlan, 2 Mar. 1972 (F. Parker and D. Miller; BBSL). **SAN LUIS POTOSÍ**: 1 ♀, 3.4 mi NE El Naranjo, 800 ft elev., 5 Sept. 1962 (University of Kansas Mexican Expedition; UKAN). **SINALOA**: 1 ♀, 5 mi E Concordia, 12 Sept. 1970 (G.E. and R.M. Bohart; BBSL). **VERA CRUZ**: 1 ♀, 3 mi SW Paso del Toro, 50 ft elev., 23 June 1961 (University of Kansas Mexican Expedition; UKAN); 1 ♂, Potrero Viejo, 1700 ft elev., 6 June 1949 (W.W. Dalquist; UKAN). **ZACATECAS**: 1 ♀, 10 mi S Jalpa, 17 Sept. 1970 (G.E. and R.M. Bohart; BBSL).

Chalicodoma (*Chelostomoides*) *reflexa*, new species

Figures 8, 18, 29, 39–41

DIAGNOSIS

Male mandible with prominent process on lower margin; procoxal process prominent; protarsal segments expanded and excavated and probasitarsus with basal row of distally hooked setae on anterior margin; discs of fourth and fifth terga black pubescent. Female unknown.

DESCRIPTION

MALE. Measurements (mm): Holotype HW 2.41; HL 2.67; WL 7.0; TL 9.0. Paratypes: HW 3.18–3.74; HL 2.46–2.97; WL 6.0–7.0; TL 9.0–10.0.

Head about 1.3 times as broad as long; inner eye margins weakly convergent below, upper interor-

bital distance about 1.1 times lower interorbital distance; in frontal view, preoccipital margin strongly elevated above eyes and ocelli. Mandible (Fig. 19) with large, triangular submedian process on lower margin; apex tridentate, inner tooth large, acute. Labrum normal, apex truncate and margins parallel. Clypeus nearly flat, apical margin weakly incurvate, with a pair of strong submedian tubercles, margin between them weakly convex; coarsely, subcontiguously punctate near base, becoming finely rugosopunctate distad; a weakly defined median impunctate line on basal one-half or less; interspaces slightly to moderately shiny. Supraclypeal area and frons dull, with contiguous moderate punctures (about 0.04 mm diameter); vertex and preoccipital area slightly shiny between fine, subcontiguous punctures; gena shinier, punctures fine to moderate, subcontiguous. Pedicel about 1.5 times longer than first flagellar segment, latter broader than long; second flagellar segment 2.2–2.5 times longer than first. Interocellar distance greater than ocellocular distance; ocellocular distance greater than ocellocipital distance.

Mesoscutum slightly shiny between moderate, subcontiguous punctures; scutellum similar but a little shinier; metanotum dull, with sparse minute, obscure punctures; mesepisternum mostly dull, moderately and contiguously punctate (rugosopunctate in some areas), but punctures a little more separated below; metepisternum and side of propodeum dull, punctures fine to moderate, contiguous, but variably rugosopunctate in some areas; propodeal disc moderately shiny and sharply tessellate, but with variable fine rugae on either side at base.

Procoxa with sparse ferruginous bristles over entire ventral surface and with dense patch at base of distal process, the process flattened and a little longer than broad. Protarsus broad, concave inner faces of first three segments smooth and shiny; first segment, along anterior margin, with about eight widely spaced, long, ferruginous bristles, which are abruptly curved mesad near their apices; probasitarsus with mastigion; last protarsal segment slender, slightly longer than proximal segment.

First metasomal tergum moderately shiny between fine, subcontiguous punctures; terga 2–4 shiny between fine to moderate punctures, interspaces mostly about one puncture diameter or a little more; tergum 5 similar but punctures mostly subcontiguous; tergum 6 dull, contiguously finely punctate, carina conspicuous in dorsal view, bilobed (Fig. 10), apical margin with prominent lateral teeth, submedian teeth prominent, acute (hidden in dense hairs); exposed sterna slightly to moderately shiny between fine, contiguous to subcontiguous punctures.

Hidden sterna. Fourth sternum hidden but not modified. Sternum 5 (Fig. 39) with lateral portion (=“presternite” of Mitchell, 1935) long and narrow; asetose in center (=“medasternite” of Mitchell, 1935), with submedian patch of stout, apically

curved setae, which become longer laterad and complexly branched; with a pair of long, slender preapical lobes, from tips of which arise a cluster of very long, simple setae curved mesobasad; apical margin with setose median tubercle and sublateral cluster of short, stout, profusely branched setae. Sternum 6 (Fig. 40) with lateral portions about as broad as long; median area with mediobasal cluster of short, simple setae and with lateral complex lobules, closely pectinate distad, bearing a few short, stout, barbed setae and numerous long, simple, acute setae; apical margin straight, simple. Sternum 8 (Fig. 41) with scattered, barbed setae on margin distad of lateral process; preapically constricted and with large distal patch of long, branched setae.

Genitalia (Fig. 29): gonocoxite long and narrow beyond base, apex obliquely capitate; volsella short and broad, apex emarginate; aedeagus slender, slightly constricted below apex, apex truncate, rounded at side.

TYPE MATERIAL

Holotype male: Estacion Biologia de Chamela, near San Patricio, JALISCO, MEXICO, 12 MAY 1980 (S.H. Bullock, #377), in Natural History Museum of Los Angeles County. Paratypes, all MEXICO: GUERRERO: 6 ♂♂, 5 mi S, 2.5 mi E Chilpancingo, 3800 ft elev., 5 Aug. 1962 (University of Kansas Mexican Expedition; UKAN); 4 ♂♂, 16 mi N Chilpancingo, 7 Aug. 1962 (N. Marston; UKAN); 2 ♂♂, 17 mi N Chilpancingo, 2550 ft elev., 13 Aug. 1962 (University of Kansas Mexican Expedition; UKAN); 1 ♂, 2 mi E Tixtla, 4925 ft elev., 8 Aug. 1962 (Ordway and Naumann; UKAN). JALISCO: 1 ♂, same data as holotype (LACM); 1 ♂, Chamela, 1–8 Oct. 1985 (F.D. Parker and T.L. Griswold; BBSL); 3 ♂♂, Río Chamela, 15–24 Apr. 1986 (F.D. Parker; BBSL); 2 ♂♂, 10 mi N Guadalajara, 16 Oct. 1968 (G.E. Bohart; BBSL); 1 ♂, Chapala, 15 Oct. 1968 (G.E. Bohart; BBSL); 3 ♂♂, Puerto Vallarta, 25 Jan. 1984 (G.E. Bohart; BBSL). MORELOS: 5 ♂♂, 4.3 mi W Yautepec, 4000 ft elev., 17 Aug. 1962 (Ordway and Marston; UKAN); 4 ♂♂, 7.3 mi S Yautepec, 3000 ft elev., 16 Aug. 1962 (Ordway and Naumann; UKAN); 3 ♂♂, Ignacio Bastida, 12 Sept. 1980 (Michener, R. Murillo, J.M. Labougle; UKAN). NAYARIT: 1 ♂, Ahuacatlan, 18–22 July 1951 (H.E. Evans; UKAN); 5 ♂♂, 9 mi NW Santa Isabella, 10 Mar. 1972 (F. Parker and D. Miller; BBSL). OAXACA: 7 ♂♂, 17 km W Tehuantepec, 8 Sept. 1965 (D.H. Janzen; UKAN), on *Caesalpinia sclerosa*; 1 ♂, 11 mi N Miltipec, 3 Mar. 1972 (F. Parker and D. Miller; BBSL); 2 ♂♂, 5 mi NW Totolopan, 3800 ft elev., 6 July 1953 (University of Kansas Mexican Expedition; UKAN), on *Lonchocarpus*; 1 ♂, 17 mi E Totolopan, 16 Sept. 1974 (W. Hanson, G. Bohart; BBSL). PUEBLA: 3 ♂♂, 3 mi NW Petlalcingo, 4 Mar. 1972 (F. Parker and D. Miller; BBSL). SINALOA: 1 ♂, 31 km N Mazatlan, 75 m elev., 29 Sept. 1976 (C.D. George and R.R. Snelling; LACM), on *Antigonon leptopus*; 2 ♂♂, Escuintla, 25 June 1956

(LACM); 2 ♂♂, 9 mi NE Chupaderos, 2 Mar. 1972 (F. Parker and D. Miller; BBSL); 1 ♂, Guamachil, 27 Oct. 1965 (G.E. and A.S. Bohart; BBSL). SONORA: 3 ♂♂, Alamos, 7 Sept. 1970 (G.E. and R.M. Bohart; BBSL); 1 ♂, Río Cucuhuquai, 7 mi S Alamos, 25 July–7 Aug. 1953 (F.S. Truxal; LACM); 1 ♂, Río Cucuhuquai, 8 mi S Alamos, 1–13 Apr. 1975 (A. Brewster; LACM), on *Cercidium*; 1 ♂, same, except on *Prosopis*.

ETYMOLOGY

The specific epithet is a Latin word for bent and refers to the row of distally reflexed setae on the probasitarsus.

DISCUSSION

Although the male *C. reflexa* resembles males of most other species with modified protarsi, this species is easily separated from all except *C. otomita* by possessing a row of hooked setae based on the anterior, inner margin of the probasitarsus. Males of *C. reflexa* may be separated from those of *C. otomita* by the presence of dark, simple hairs on the discs of the last three terga, rather than appressed, more or less fulvous, plumose hairs. Also, in *C. reflexa*, the fourth protarsal segment is asymmetrical, with the anterior lobe strongly produced; in *C. otomita* the fourth protarsal segment is symmetrical.

The unknown female of *C. reflexa* is probably similar to that of *C. otomita* but will likely have whitish rather than fulvous pubescence. Probably, too, the discs of terga 4 and 5 will be dark pubescent.

Known floral records include only two families. BIGNONIACEAE: *Antigonon leptopus*. FABACEAE: *Caesalpinia sclerocarpa*, *Cercidium* sp., *Lonchocarpus* sp., *Prosopis* sp.

Chalicodoma (*Chelostomoides*) *subexilis* (Cockerell)

Megachile subexilis Cockerell, 1903:292; ♀.

Megachile semiexilis Cockerell, 1908:292; ♀♂.

Megachile (*Chelostomoides*) *subexilis*: Mitchell, 1937:384, 385, 394–396; ♀♂. Mitchell, 1956:131, 134, 137; ♀♂.

Among those species in which the female possesses a preapical groove on tergum 6, the female of *C. subexilis* is easily recognized by the exceptionally prominent submedian tubercles of the clypeal margin and the presence of a pubescent fascia on the apical margin of tergum 5. The male differs from others with a ventral mandibular process and grooved protarsi in possessing only reclinate, simple setae over most of the procoxa (which has a prominent distal process) and in lacking a mastigion at the base of the probasitarsus.

This is a moderately common montane species that ranges from Nebraska and Colorado west to California.

Nectar and/or pollen sources encompass 27 plant genera in 11 families. Known floral associations include the following. AMARYLLADACEAE: *Alium* sp. ANACARDACEAE: *Rhus trilobata*. ASTERACEAE: *Erigeron neomexicanus*, *Helenium* sp., *Helianthus* sp., *Verbesina encelioides*. CACTACEAE: *Opuntia* sp. CAPPARIDACEAE: *Cleome serrulata*. FABACEAE: *Amorpha* sp., *Cracca edwardsii*, *Desmodium batocaulon*, *Lathyrus arizonica*, *L. graminifolius*, *L. odoratus*, *Lotus* sp., *L. corniculatus*, *L. oroboides*, *Lupinus palmeri*, *Medicago sativa*, *Melilotus* sp., *Oxytropis lambertii*, *Phaseolus* sp., *Psoralea tenuiflora*, *P. wrightii*, *Trifolium* sp., *T. pinetorum*, *T. pratense*, *Vicia* sp., *V. pulchella*, *V. villosa*. GERANIACEAE: *Geranium* sp. HYDROPHYLLACEAE: *Phacelia* sp. LAMIACEAE: *Marrubium vulgare*, *Monarda* sp., *M. austromontana*, *M. pectinata*, *Salvia* sp. RHAMNACEAE: *Ceanothus fendleri*. ROSACEAE: *Chamaebatiaria millefolium*.

Nests have been found in adobe walls, sandstone, and in borings in wood. Known megachilid cleptoparasites include *Dioxys pomonae* Cockerell (Hurd, 1958) and *Coelioxys gilensis* Cockerell (Hicks, 1927).

Group II (*georgica* Group)

GROUP CHARACTER. Male mandible slender, tridentate, without ventral process, hypostomal acetabulum present; male protarsal segments broad, flat, basitarsus densely setose on inner surface; female clypeal disc simple, apical margin strongly tuberculate, but without median tubercle; female tergum 6 without preapical groove.

INCLUDED SPECIES. *Chalicodoma georgica* (Cresson).

The one species in this group flies primarily during the summer and fall months and is limited to the southeastern United States. Although most floral records are from legumes, *C. georgica* appears to be polylectic.

Because of the simple clypeal structure, females most closely resemble those of Group I (*exilis* group) but are easily separated by the lack of a preapical groove on tergum 6. Males, by virtue of the broad, flattened protarsus, resemble those of Group III (*occidentalis* group) but have the probasitarsus setose rather than densely tomentose on the inner surface. Additionally, males of *C. georgica* have a prominent procoxal process that is about twice longer than its basal breadth.

Chalicodoma (*Chelostomoides*) *georgica* (Cresson)

Megachile georgica Cresson, 1878:123; ♀♂.

Megachile penicillata Cockerell, 1915:536; ♀.

Megachile (*Chelostomoides*) *georgica*: Mitchell, 1937:384, 386, 396–398; ♀♂. Mitchell, 1956:135, 137; ♀♂.

Among those species in which the female lacks a transverse groove on tergum 6 and which possess a stout, quadridentate mandible, the female may be recognized by the transverse apical clypeal margin with only weak and irregular denticulae. The clypeal disc is flat and sparsely covered with simple setae; only at the sides are there conspicuous, plumose hairs. The male falls within that small group that is characterized by possessing broad, flat, protarsal segments. From the only other species with similar tarsi (*C. davidsoni*, *C. occidentalis*, and *C. prosopidis*), males of *C. georgica* may be separated by the prominent procoxal process and the presence of reclinate, simple setae on the inner surface of the probasitarsus.

This is an eastern species, ranging from Maryland and New Jersey south to Florida; westward, the range extends to Arkansas and eastern Texas. A polylectic species, *C. georgica* has been taken on plants belonging to 21 genera, representing eight families; the bulk of the records are from legumes. Known floral associations for *C. georgica* include the following. ASTERACEAE: *Chrysopsis* sp., *Erigeron* sp., *Helenium* sp., *Helianthus* sp. CLETHRACEAE: *Clethra alnifolia*. ERICACEAE: *Vaccinium* sp. FABACEAE: *Azelia cassinoides*, *Amorpha* sp., *Baptisia tinctoria*, *Calactia* sp., *Crotalaria* sp., *Desmodium* sp., *Melilotus* sp., *Phaseolus* sp., *Psoralea* sp., *Tephrosia virginiana*. HYPERICACEAE: *Hypericum* sp. LAMIACEAE: *Pycnanthemum hypsifolia*, *Stachys* sp. LOBELIACEAE: *Lobelia* sp. SCROPHULARIACEAE: *Pentstemon* sp.

Krombein (1967) reared the parasitoides *Leucospis affinis floridana* Cresson (Leucospidae) and *Coelioxys modesta* F. Smith (Megachilidae) from nests of *C. georgica* in Florida. The flight period extends from March to November (Mitchell, 1962).

Group III (*occidentalis* Group)

GROUP CHARACTERS. Male mandible tridentate and moderately long, with prominent ventral process; hypostomal acetabulum present, exposed; male protarsal segments broad, flattened, and basal segments densely tomentose on inner surface; female mandible long, with three or four apical teeth and with upper, outer carina more or less elevated near base; female clypeal disc bizarre and apical margin concealed and simple; female tergum 6 without preapical groove.

INCLUDED SPECIES. *Chalicodoma davidsoni* (Cockerell), *C. occidentalis* (W. Fox), and *C. prosopidis* (Cockerell).

The three species of this group are found in arid and semiarid regions of the southwestern United States and adjacent Mexico. Two species occur in lowland habitats, and one is known only from the mountains of southern and central California. The two lowland species are polylectic and the montane species appears to be oligolectic.

Chalicodoma (Chelostomoides)
 davidsoni (Cockerell)

Figures 4, 61, 62

Megachile davidsoni Cockerell, 1902:70; ♀.
Megachile occidentalis var. *leucotricha* Cockerell,
1902:137; ♂.
Megachile (Chelostomoides) davidsoni: Mitchell,
1937:384, 401–402; ♀ ♂. Mitchell, 1956:132, 134,
137; ♀ ♂.

Both sexes of this species, the largest in the subgenus, are easily recognized by the characters cited in the key. The large, prominent processes on the mandible and clypeus are characteristic for the female as are the subcarinate clypeus and expanded, flattened protarsi of the male, but with the prodististars much longer than the other segments.

Although Hurd (1979) cited *C. davidsoni* from Arizona, I have seen specimens only from California, where all previous records are from the San Gabriel, San Bernardino, and San Jacinto mountain ranges. However, a series of specimens extends the range north along the western slopes of the Sierra Nevada to Fresno Co.: 2 ♀, 18 ♂, 5.5 mi NE Tollhouse, 26 June 1982 (J.A. Halstead; HALS), on *Dicentra* sp. probably *chrysantha*; 1 ♀, Clingan's Junction, Hwy. 180, 3500 ft elev., 7 July 1955 (R.Y. Berg; UCB), on *D. chrysantha*.

Available records show a flight period extending from late May to mid-July in southern California.

Although the females are presumed oligoleges on *Dicentra* for pollen, *C. davidsoni* has been recorded from the following plants. ASTERACEAE: *Senecio* sp. FABACEAE: *Lathyrus* sp., *Lupinus austromontanus*. FUMARIACEAE: *Dicentra* sp., *D. chrysantha*. SCROPHULARIACEAE: *Penstemon grinnellii*. STERCULIACEAE: *Fremontia* sp.

Chalicodoma (Chelostomoides)
 occidentalis (W. Fox)

Figures 69, 70

Megachile occidentalis W. Fox, 1894:117; ♂.
Megachile prosopidis var. *testudinis* Cockerell,
1924:550; ♀.
Megachile (Chelostomoides) ignacensis Mitchell,
1934:352; ♀. NEW SYNONYMY.
Megachile (Chelostomoides) occidentalis: Mitchell,
1937:384, 385, 398–401; ♀ ♂ (in part). Mitchell,
1956:132, 134, 137; ♀ ♂ (in part).

The name *C. occidentalis* is not used here in the sense of Mitchell (1934) and subsequent authors. It is my belief that *C. occidentalis* has been persistently misidentified and that the correct name for the species long known as *C. occidentalis* is *C. prosopidis*.

Fox (1894) described *Megachile occidentalis* from a single male from San Ignacio, Baja California Sur, Mexico. When Mitchell (1934) revised the species of *Chelostomoides*, he associated this specimen with other males ranging from southern California to

western Texas, and with females that had been described by Cockerell (1900) as *M. prosopidis* from Mesilla, New Mexico. Although I cannot prove that this association is incorrect, I believe, nevertheless, that this is the case. The type locality of *C. occidentalis* is in Baja California Sur. And, although I have seen a number of males from this part of Mexico that match very well with the type, I have seen no females from there that correspond to the interpretation of Mitchell (i.e., *C. prosopidis*). These males are consistently associated with those females described by Mitchell (1934) as *M. ignacensis*. It should be noted that the type of *M. ignacensis* was collected at the same time and place as the type of *M. occidentalis*.

The two species, as represented by the female types (*M. prosopidis* and *M. ignacensis*), are so very similar in mandibular and clypeal structure that their close relationship appears to be inarguable. However, the mandible of the *C. occidentalis* female has a prominent, blunt, tooth-like process on the upper margin (Fig. 70), whereas in *C. prosopidis* the dorsal ridge is low and convex (Fig. 72). The lateral processes of the clypeus are broad, and the apex of the median process is transverse or weakly convex in *C. occidentalis* (Fig. 69). In *C. prosopidis* the lateral processes are corniform, and the median process is distinctly produced in the middle (Fig. 71). Finally, in females of *C. occidentalis*, the distance from the base of the clypeus to the apex of the median lobe is much less than the interantennal distance, whereas in *C. prosopidis* it is subequal to the interantennal distance.

In view of the obvious similarities of the females of *C. occidentalis* and *C. prosopidis*, the males should also be similar to one another. In fact, at this point, I am unable to distinguish two species on the basis of the males. For the present, males can only be separated geographically.

There is no demonstrable evidence that females of the *C. prosopidis* type are present in central and southern Lower California. Instead, in this portion of Mexico, they are replaced by the females that I presume are truly those of *C. occidentalis*. *Chalicodoma occidentalis*, as interpreted here, is limited to the Lower California peninsula; records of *C. occidentalis* from the United States and mainland Mexico should be transferred to *C. prosopidis*.

The few specimens recorded here will augment the limited information on this species. MEXICO, BAJA CALIFORNIA: 2 ♀, 6 mi S Okie Landing, 13 June 1968 (M. Cazier et al.; ARSU); 1 ♂, Cataviña, 19 June 1983 (L. Stange and R. Miller; FSCA); 1 ♀, Cerro de Cedros, Isla Cedros, 1 July 1983 (D.K. Faulkner; SDM); 2 ♀, 13 km NW Rosarito, 9 Sept. 1977 (R.R. Snelling; LACM); 1 ♂, same except (E.M. Fisher and R.L. Westcott; CAS); 1 ♀, San Antonio Microwave Tower, 27 Aug. 1982 (Faulkner and Brown; SDM). BAJA CALIFORNIA SUR: 1 ♀, 13 mi SW La Purissima, 2 July 1968 (M. Cazier et al.; ARSU); 1 ♀, 32 mi NW La Paz, 15 Mar. 1980 (J.L. Neff; NEFF), on *Cercidium peninsulare*; 1 ♀, 1 ♂,

52 mi NW La Paz, 15 Mar. 1980 (J.L. Neff; NEFF), on *C. peninsulare*; 1 ♂, 10 mi S La Paz, 16 Oct. 1972 (C.D. Michener; UKAN); 1 ♂, 20 km NW La Paz, 5 Oct. 1975 (R.R. Snelling; LACM); 1 ♀, 3 mi S La Paz, 13 Mar. 1980 (J.L. Neff; NEFF), on *C. peninsulare*; 1 ♂, 2.5 mi S jct. Hwys. 1 and 19, 27 Aug. 1982 (Faulkner and Brown; SDM); 1 ♂, 4 km N Los Barriles, 10 m elev., 4 Sept. 1977 (R.R. Snelling; LACM); 1 ♀, 19 mi SE El Cien, 27 Sept. 1981 (D. Faulkner and F. Andrews; SDM); 1 ♂, Mulegé, 24 Sept. 1981 (D. Faulkner and F. Andrews; SDM); 1 ♀, 12.8 mi SE Santa Rosalia, 21 Sept. 1981 (D. Faulkner and F. Andrews; SDM); 21 ♀♀, 1 ♂, 5 mi NW San Ignacio, 13 and 19 Sept. 1983 (R.R. Snelling; LACM), on *Tephrosia tenella*.

The presently known floral records are all within the family Fabaceae.

Chalicodoma (Chelostomoides) prosopidis (Cockerell)

Figures 71, 72

Megachile prosopidis Cockerell, 1900:16; ♀.

Megachile (Chelostomoides) occidentalis: Mitchell, 1937:384, 385, 398–401; ♀ (in part). Mitchell, 1956:132, 134, 137; ♀ (in part).

This is a moderately common and widely distributed species in arid western North America, from Texas to California. It was long known as *C. occidentalis*, but that name must now be applied to a morphologically similar species limited to the Lower California peninsula of Mexico. For separation from *C. occidentalis*, see discussion under that species.

Previous records of this bee in California have been limited to the southern counties (Imperial, Inyo, Los Angeles, Riverside, San Bernardino, and San Diego Counties). Mitchell (1937) cited a specimen from Los Mochis, Sinaloa, Mexico.

The following records extend the known range in California and Mexico. UNITED STATES, CALIFORNIA, Fresno Co.: 1 ♂, Fresno, 22 July 1970 (E.A. Kane; CDFA), on *Helianthus*; 2 ♀♀, Fresno, 27 and 31 May 1982 (J. Halstead; HALS); 1 ♂, 8 mi W Kerman, 2 Aug. 1960 (R.R. Snelling; LACM), on *Wislizenia refracta*; 1 ♂, 4 mi SE Orange Cove, 18 June 1957 (R.R. Snelling; LACM). Madera Co.: 1 ♂, Madera, 15 June 1982 (J. Halstead; HALS); 1 ♂, 8 mi S Madera, 17 June 1957 (R.R. Snelling; LACM), on *Helianthus*. Stanislaus Co.: 2 ♂♂, Turlock, 2 May and 15 June 1953 (R.R. Snelling; LACM); 1 ♀, Turlock, 4 Oct. 1954 (R.R. Snelling; LACM), on *Citrullus vulgaris*. MEXICO, CHIHUAHUA: 1 ♂, 10 mi N Chihuahua, 22 Sept. 1950 (R.M. Bohart; UCD); 1 ♂, Santo Niño, 10 Aug. 1968 (T.A. Sears, R.C. Gardner, C.S. Glaser; UCD); 1 ♂, 2 mi N Temoris, 17 Aug. 1968 (same; UCD); 8 ♂♂, 4 mi NW Choix, 27 Aug. 1968 (same; UCD). SONORA: 2 ♂♂, La Aduana, 12 June 1961 (A.S. Menke and L.A. Stange; LACM); 2 ♀♀, 5 mi E Navojoa, 2 Aug. 1960 (Arnaud, Ross, Rentz; CAS); 1 ♂, Río

Chuchuhaqui, 7 mi S Alamos, 25 July–7 Aug. 1953 (F.S. Truxal; LACM); 5 ♂♂, 6 km NNW San Carlos, 11–15 July 1983 (E.M. Fisher; CDFA). ZACATECAS: 1 ♂, 22°40'N, 104°03'W, 7 Sept. 1984 (W.J. Pulawski; CAS).

Chalicodoma prosopidis is primarily a summer flying species with the bulk of the flight records during the months of June, July, and August. Floral records include plants of 30 genera, representing 14 families. AGAVACEAE: *Nolina parryi*. ANACARDIACEAE: *Schinus molle*. ASTERACEAE: *Chrysothamnus* sp., *Geraea canescens*, *Helianthus* sp., *Lepidospartum squamatum*, *Pectis papposa*, *Pluchea camphoratum*, *Senecio* sp., *Vernonia* sp. BIGNONIACEAE: *Chilopsis linearis*. BRASSICACEAE: *Stanleya pinnata*. CAPPARIDACEAE: *Cleome* sp., *Wislizenia refracta*. CUCURBITACEAE: *Citrullus vulgaris*. EUPHORBIACEAE: *Croton californicus*. FABACEAE: *Cercidium floridum*, *Hoffmannseggia* sp., *H. densiflora*, *Lotus* sp., *Medicago sativa*, *Parkinsonia* sp., *P. aculeata*, *Prosopis* sp., *Psoralea emoryi*, *P. scoparius*, *Vicia cracca*. HYDROPHYLLACEAE: *Phacelia* sp. LAMIACEAE: *Marrubium vulgare*. TAMARICACEAE: *Tamarix gallica*. VERBENACEAE: *Duranta plumieri*, *Lippia nodiflora*. ZYGOPHYLLACEAE: *Larrea tridentata*.

The meloid beetle *Nemognatha lurida* LeConte has been reared from nests of this bee (Hurd, 1979). Nests have been found in a variety of situations, including adobe and brick walls, dead wood, and trap nests.

Group IV (*abacula* Group)

GROUP CHARACTERS. Male mandible short, broad, and obscurely quadridentate, without ventral process; hypostomal acetabulum absent; male protarsal segments slender, inner surface flat and densely setose; female mandible short and broad, with four apical teeth; female clypeal disc unmodified and apical margin produced in middle and denticulate or tuberculate, with median denticle; male clypeal margin with prominent medial tubercle; female tergum 6 without preapical groove.

INCLUDED SPECIES. *Chalicodoma abacula* (Cresson) and *C. alucaba*, n. sp.

The two species in this group range from central Mexico south to Costa Rica. Both appear to be uncommon, and little is known about their floral biology.

Chalicodoma (Chelostomoides) abacula (Cresson)

Figures 14, 15

Megachile abacula Cresson, 1878:130–131; ♀.

Megachile gualanensis Cockerell, 1912:27; ♀. NEW SYNONYMY.

The types of *M. abacula* and *M. gualanensis*, both females, are in the USNM, and I have examined

them and find no differences sufficient to warrant their separation.

Specimens of *C. abacula* from Mexico and Guatemala are easily recognized by the presence of numerous reclinate, plumose hairs on the discs of terga 4 and 5 of both sexes; most commonly, these hairs are fulvous. Males are further characterized by the short mandibles without a ventral process, the prominent median tubercle on the clypeal margin, the simple procoxa and protarsus, and the evanescent carina of tergum 6. The females also possess short, broad mandibles and the clypeus is subangularly convex from side to side, with the apical margin a little protuberant in the middle and with a prominent median tubercle. The mesepisternum is rugosopunctate. Both sexes also possess conspicuous, blackish hairs among the white clypeal hairs. Specimens from Costa Rica differ from those I have seen from Mexico and Guatemala. The pubescence of the abdominal terga is almost invariably whitish rather than fulvous and, in both sexes, the reclinate, plumose discal hairs are greatly reduced in number. Usually none are present on the disc of tergum 4 in both sexes. Tergum 5 usually has numerous such hairs in the male, but in the female they are sparse and generally limited to the posterior one-half, or less, of the segment.

These Costa Rican specimens are very similar to *C. alucaba*, described below, and, in the absence of associated males, it may prove difficult to distinguish between the two species. At present, *C. alucaba* is known only from Mexico, where the characteristics of *C. abacula* are best defined. It seems reasonable to assume that character displacement is involved where the two species are sympatric. Much more material of both species, from additional localities, will be necessary before it is possible to understand their relationship.

The following are new records for *C. abacula*. MEXICO, CHIAPAS: 1 ♀, Francia, 8 mi NE Cintalapa, 3 Apr. 1953 (R.C. Bechtel and E. I. Schlinger; BBSL). OAXACA: 4♀♀, 1 ♂, 4 mi N Pochutla, 150 m elev., 11 Oct. 1975 (J.L. Neff, NEFF), on *Salvia*. HONDURAS: 1 ♂, Jinca San Francisco, 30 Jan. (W.P. Cockerell; BBSL); 1 ♂, locality unreadable, Feb. (M.A. Willows; BBSL). NICARAGUA: 1 ♀, San Marcos (Baker; LACM). COSTA RICA, GUANACASTE: 3 ♂♂, La Pacifica, 4 mi NW Cañas, 25–30 Jan. 1972 (P.A. Opler; UCB), on *Melanthera nivea*; 1 ♀, 1 ♂, same locality and collector, 1972 on *M. nivea*; 2 ♀♀, same locality and collector, 15–20 Sept. 1973, on *Cordia collococca*; 158 ♀♀, 6 ♂♂, Liberia, 15–16 Feb. 1972 (P.A. Opler; UCB), on *Andira inermis*; 36 ♀♀, 4 ♂♂, same locality and collector, 23–26 Feb. 1972, on *A. inermis*; 6 ♀♀, same locality and collector, 1 Mar. 1972, on *A. inermis*; 1 ♀, Comelco, 8 km NW Bagaces, 25 Mar. 1972, on *Lonchocarpus costaricensis* (all UCB).

The above floral records represent the following families. ASTERACEAE: *Melanthera nivea*. BORAGINACEAE: *Cordia collococca*. FABACEAE: *Andira inermis*, *Lonchocarpus costaricensis*.

Chalicodoma (*Chelostomoides*) *alucaba*, new species

Figures 1, 4, 20, 30, 36–38

DIAGNOSIS

Male with unmodified protarsus and without ventral mandibular process; carina of tergum 6 low and inconspicuous, weakly bilobate; clypeus with prominent median process, but lateral processes weak; third mandibular tooth with a small, conical tubercle on inner surface. Female with short, broad mandible and tergum 6 without preapical groove; apical margin of clypeus produced and with small median process and some erect fuscous to blackish hairs on disc; tergum 5 without traces of marginal hair band.

DESCRIPTION

FEMALE. Measurements (mm): HW 2.71–2.95; HL 2.24–2.43; WL 5.3–5.6; TL 9.4–10.5.

Head about 1.2 times as broad as long; inner eye margins very weakly convergent below, upper interorbital distance less than 1.1 times lower interorbital distance; in frontal view, vertex-preocciput elevated above ocelli by considerably less than transverse diameter of anterior ocellus. Mandible robust, apical margin with four well-defined teeth and with a weak tooth between third and fourth (inner) teeth. Sides of labrum mostly subparallel, narrowed preapically, without median, preapical seta-pit. Apical margin of clypeus slightly produced and with low median denticle, margin on either side irregular but without definite denticles; disc with very narrow median impunctate line, broadest basad, otherwise contiguously, moderately punctate, median line and interspaces smooth and shiny. Supraclypeal area shiny between contiguous, moderate punctures, but interspaces progressively less shiny above, merging to slightly shiny interspaces between contiguous, moderate punctures of frons; vertex and preocciput similar to frons, but with some irregular interspaces up to one-half puncture diameter. Gena, at widest, about one-half as wide as eye, shiny between contiguous, fine to moderate punctures. Pedicel about twice longer than first flagellar segment and less than twice longer than second; first flagellar segment broader than long; median flagellar segments slightly longer than broad. Interocellar distance greater than ocellular distance, each distinctly greater than ocellocipital distance.

Mesoscutum and scutellum moderately shiny between mostly contiguous, moderate punctures, scutellum with a few coarse punctures; mesepisternum, metepisternum, and side of propodeum similar, with punctation on anterior portion of mesepisternum tending toward rugosopunctate.

Discs of terga 1–5 moderately shiny, that of first tergum with subcontiguous, fine to moderate punctation.

tures, those of terga 2–5 similar, but punctures a little more separated and with fewer fine punctures; depressed apical margins with contiguous, fine punctures at base, but with narrow, impunctate rims; tergum 6 slightly shiny between contiguous, fine punctures; preapical groove absent.

Integument generally blackish, flagellum and legs dark reddish brown. Tegula medium brown, becoming transparent yellowish brown toward margins. Wings transparent light brown; veins and stigma dark to medium brown.

Pilosity about as in other *Chelostomoides*, but clypeal disc with a few light brownish hairs, frons and vertex with numerous dark brown to blackish hairs; humeral angle of pronotum with flocculent hair patch; terga 2–5 with basal fasciae of appressed, plumose, white hairs and terga 2–4 with narrow apical fasciae of similar hairs, tergum 5 without apical band; terga 2–5 with sparse, very short, simple, yellowish to brownish hairs across discs and a few long, simple, whitish hairs at sides; tergum 6 with short, subappressed, short-plumose, pale hairs; scopa whitish on sterna 2–5, dark brown on 6.

MALE. Measurements (mm): Holotype HW 2.71; HL 2.24; WL 5.2; TL 8.3. Paratypes: HW 2.62–2.90; HL 2.14–2.52; WL 5.1–5.8; TL 7.5–8.7.

Head about 1.2 times as broad as long; eyes weakly convergent below, upper interorbital distance about 1.2 times lower interorbital distance; preoccipital margin arcuately produced above ocelli by about diameter of anterior ocellus. Mandible (Fig. 20) weakly quadridentate, second (subapical) tooth very low and blunt, interspace between third and fourth teeth broad and deep; a low, conical tubercle present on inner side of fourth tooth. Labrum as in female. Apical margin of clypeus nearly straight between weak lateral tubercles and with large median tooth (Fig. 1); disc dull, finely to moderately rugosopunctate. Frons slightly shiny, finely rugosopunctate, grading to contiguously to subcontiguously, moderately punctate on vertex-preocciput. Gena, in profile, nearly as wide as eye, with moderate punctures. Pedicel about twice longer than first flagellar segment, and about as long as second; middle flagellar segments about 1.5 times longer than wide. Interocellar distance less than ocellocular distance, latter about equal to ocellocapital distance.

Mesosoma about as described for female.

Metasomal terga 1–5 about as in female, but apical margins transparent yellowish and not vertically depressed from discs; carina of tergum 6 low and obscure, with very weak median emargination, apical margin without traces of lateral or submedian teeth.

Hidden sterna and genitalia (Figs. 30, 36–38).

Color as described for female.

Pilosity about as in female, except metasomal terga 1–3 with apical hair bands incomplete and present as lateral patches only, terga 4–5 entirely devoid of apical hair bands; tergum 6 without basal hair band, disc with short, sparse, simple hairs only.

TYPE MATERIAL (MEXICO)

Holotype male: 9.2 km W Guadalajara, *JALISCO*, 8–9 Sept. 1976 (C.D. George and R.R. Snelling), in LACM. Paratypes: 2 ♂♂, same data as holotype; 1 ♂, 10 mi N Guadalajara, *JALISCO*, 16 Oct. 1968 (G.E. Bohart); 1♂, 30 mi NE Guadalajara, *JALISCO*, 17 Sept. 1970 (R.M. Bohart); 1 ♂, 10 mi S Jalpa, *ZACATECAS*, 17 Sept. 1970 (G.E. and R.M. Bohart); 1 ♀, Juchipila, *ZACATECAS*, 17 Oct. 1968 (G.E. Bohart); 1 ♀, 5 mi N Chila, *PUEBLA*, 14 Oct. 1975 (J.L. Neff); 1 ♀, Concordia, *SINALOA*, 12 Mar. 1972 (F.D. Parker and D.R. Miller). Paratypes in BBSL, LACM, and UCD.

ETYMOLOGY

The specific name is that of the presumed nearest relative, *C. abacula*, spelled in reverse.

DISCUSSION

Since the most distinctive features of this species are exhibited by the males, I have departed from my usual procedure in this paper in selecting this sex for the holotype. In addition, the association of the two sexes is only presumptive; the few females may prove to be only variants of *C. abacula*.

The females here associated with *C. alucaba* are very similar to those of *C. abacula*. Females of the latter species commonly have much, or all, of the disc of metasomal tergum 5 covered by short, plumose, appressed hairs. These hairs are usually whitish in Mexican specimens but may be yellowish, as in some from Costa Rica. Similar hairs may also be present, though sparse, on the disc of tergum 4. The apical margin of tergum 5 has a complete band of similar hairs; the band is sometimes interrupted in the middle, apparently due to abrasion. The few females here presumed to be those of *C. alucaba* have no plumose hairs on the discs of terga 4 and 5, and there is no apical pubescent fascia on 5.

Females and males of both species possess conspicuous, very long, brownish to blackish hairs on the frons and similar hairs are also conspicuously present on the clypeus of both sexes of *C. abacula*. Although they are present on the clypeus of *C. alucaba*, they tend to be light yellowish brown in that species and are much less conspicuous.

The male of *C. alucaba* is easily recognized by the presence of a minute denticle on the inner side of the fourth mandibular tooth; this feature appears to be unique within the New World fauna. Additionally, the unusually prominent median denticle of the clypeal margin is characteristic of the *C. alucaba* male.

Group V (*armaticeps* Group)

GROUP CHARACTERS. Male mandible stout and tridentate, with small ventral process; hypostomal acetabulum absent; male first flagellar segment about one-third as long as second; male protarsal

segments slender and densely setose on inner surfaces; female mandible stout and obscurely quinquedentate; female clypeal disc bizarre, apical margin exposed and without denticles; supraclypeal process present; female metasomal tergum 6 without preapical groove.

Only the Cuban species *C. armaticeps* is assigned to this group; as unusual combination of character states obscures the relationships of this species. The male has a small triangular process at the midlength of the ventral margin of the mandible (as in Groups I–III) but the protarsal segments are slender and unmodified (as in Groups IV and VI–X). The female face is bizarre, but the mandibles are stout and obscurely five-toothed. Particularly noteworthy of the female is the presence of a large, curved supraclypeal process, a unique feature within known *Chelostomoides*.

Chalicodoma (Chelostomoides) *armaticeps* (Cresson)

Figures 75–78

Megachile armaticeps Cresson, 1869:296; ♀.

Cresson (1869) described this species from a single female from “Cuba”; the type is in the Gundlach collection at the Academia de Ciencias de Cuba, in Havana (Alayo, 1970). According to Alayo, this species is rare and is known only from the south coast of Oriente Province. I have examined a single pair of specimens collected by P. Alayo at Juragua, Oriente Province, Feb. 1959 (UKAN).

Although female *Chelostomoides* often are characterized by bizarre clypeal and/or mandibular configurations, the female of *C. armaticeps* is the most grotesque of any species known to me. From each side of the clypeus, a large, flattened lobe projects at right angles to the face. Between these lobes, at the apical margin, is an erect T-shaped protuberance. Another process originates on the supraclypeal area; it is erect and thin, but abruptly curved toward the median clypeal process (Figs. 75, 76).

Aside from these facial features the female is rather ordinary. The mandible is short and broad, with five apical teeth. The two middle teeth are fused and difficult to distinguish, and the two innermost teeth (similarly fused) are separated from the middle tooth-pair by a deep, narrow excision. There is no basal mandibular prominence. The sixth metasomal tergum is without a transverse preapical groove.

A flocculent hair patch is present at each side of the pronotum and similar hairs are present along the margins of the mesoscutum adjacent to the regulae. There are also short notaular patches of short, flocculent hairs. Metasomal terga 1–5 each possess a narrow apical band of appressed, plumose, white hairs; terga 2 and 3 additionally have weak postgradular bands of pale hairs. The scopa is mostly pale but is black on the last segment.

The male of *C. armaticeps* is much less remarkable in appearance. The mandible is stout and tridentate; a triangular process is present at about midlength on the ventral margin, but the process is relatively small (Fig. 77). The apical margin of the clypeus is thin and slightly protuberant, weakly concave in the middle (i.e., weakly bilobate medially); the disc is mostly coarsely and contiguously punctate but medially with a broad impunctate line that extends from the base nearly to the apical margin. A small interantennal tubercle is present at the lower end of the frontal suture.

The male procoxa has an apical spine; this spine is erect and longer than its basal breadth; the disc of the segment is largely bare, with only scattered, short, plumose, pale hairs; longer plumose hairs are present along the margins and across the base. The protarsal segments are simple; i.e., they are slender and the inner surfaces are densely covered by short, stiff, simple hairs. The base of the probasitarsus lacks a mastigion.

The discal carina of metasomal tergum 6 of the male is strongly protuberant and with a deep median emargination (Fig. 78). The lateral teeth on the apical margin of tergum 6 are prominent and angulate; the median teeth are present as long, low, rounded lobes. Genitalia and associated structures were not extracted from the one specimen available to me.

Pilosity of the mesosoma is much the same as that of the female described above. Apical hair bands are present, but incomplete, on metasomal terga 1–5, increasingly more broadly interrupted on succeeding segments. Terga 3–6 possess distinct postgradular pubescent fasciae.

Group VI (*rugifrons* Group)

GROUP CHARACTERS. Male mandible slender, tridentate, without ventral process; hypostomal acetabulum absent; male first flagellar segment one-third, or less, as long as second; male protarsal segments slender, densely setose on inner surface; female mandible slender to very slender, tridentate; female clypeal disc bizarre, apical margin concealed and without denticles; female tergum 6 without preapical groove.

INCLUDED SPECIES. *Chalicodoma browni* (Mitchell), *C. chilopsidis* (Cockerell), *C. discorhina* (Cockerell), *C. lobatifrons* (Cockerell), *C. odontostoma* (Cockerell), and *C. rugifrons* (F. Smith).

This is a group found primarily in the arid and semiarid regions of the southwestern United States and adjacent Mexico, but with one species (*C. rugifrons*) found in the eastern United States.

Chalicodoma (Chelostomoides) *browni* (Mitchell)

Figures 2, 5, 57, 58

Megachile (Chelostomoides) browni Mitchell, 1934: 354; ♂.

Megachile (Chelostomoides) felipiana Mitchell, 1937:405; ♀.

Megachile (Chelostomoides) browni: Timberlake, 1957:132; ♀♂.

Morphologically, *C. browni* is most similar, in both sexes, to *C. odontostoma*. Females of *C. browni* are easily recognized by the characteristic broad, lateral clypeal lobes (Fig. 50). Males of the two species are much more similar. Mitchell (1956) attempted to separate the males on the basis of slightly different clypeal configuration and differences in the lengths of the first and second flagellar segments.

The outline of the clypeal margin is variable in males of *C. odontostoma*, and I have seen a series of males of this species in which the configuration matches that described for *C. browni*. The relative lengths of the first and second flagellar segments are useful, though the difference between the two species is not as described by Mitchell. It is true that in *C. odontostoma* the second segment is about three times as long as the first (range: 2.75–3.00). It is not true, however, that in *C. browni* the second segment is four times as long as the minimum length of the first. In the specimens I have been able to examine, the range is second segment 3.33 to 3.67 times longer than the minimum length of the first segment.

In addition to the difference in the flagellar segments, the top of the head is smooth and shiny between punctures in *C. browni* males; the interspaces are polished and without traces of tessellation. Tessellation is conspicuous in the interspaces in *C. odontostoma*, and the integument is only slightly shiny. Much the same is true of the mesoscutum, and, in general, *C. browni* is shinier than *C. odontostoma*.

Whereas males of both species possess flocculent hairs laterad on the pronotal collar, in *C. browni* these hairs form a conspicuous, compact cluster, rather than being well spaced as in *C. odontostoma*. For further description of *C. browni*, see Mitchell (1934).

This is one of the less commonly collected species of *Chalicodoma* in the western deserts. There are only a few previous records: two from Arizona (Yuma, the type locality, and Santa Rita Mountains), two from California (San Felipe Valley and Magnesia Canyon), and one from Baja California, Mexico (Bahia de Los Angeles).

The following are new records for *C. browni*. UNITED STATES, ARIZONA, Coconino Co.: 1 ♀, 6 mi S Sedona, 29 July 1977 (J.D. Pinto; UCR). Gila Co.: 1 ♀, Salt River Canyon, 7 June 1971 (G.W. Apperson; BBSL). La Paz Co.: 1 ♀, 18 mi SE Parker, 7 May 1966 (S.A. Gorodenski, J.M. Davidson, M.A. Cazier; ARSU), on *Asclepias erosa*. Yavapai Co.: 1 ♂, 5 mi N Yarnell, 22 June 1971 (G. Bohart and P. Torchio; BBSL), on *Eriodictyon angustifolium*; 1 ♂, Yarnell, 22 June 1971 (G. Bohart and P. Torchio; BBSL), on *Melilotus alba*; 5 ♀♀, 2♂♂, same locality,

10 July 1959 (LACM). CALIFORNIA, Imperial Co.: 1 ♂, Glamis, 26 Apr. 1972 (J.L. Neff, No. 63875; LACM), on *Asclepias subulata*. Inyo Co.: 14 ♀♀, 4 ♂♂, Tecopa, 8 June 1983 (K.W. Cooper; KWC), on *Prosopis*. Riverside Co.: 1 ♀, Blythe, 24 May 1971 (M.S. Wasbauer; CDFA), on *Cercidium*; 5 ♀♀, 1 ♂, 2 mi NW Blythe, 31 Apr. 1972 (F. Parker, P. Torchio, G. Bohart; BBSL). San Bernardino Co.: 2 ♂♂, Twentynine Palms, 14 May 1981 and 18 May 1983 (K.W. Cooper; KWC), on *Prosopis*. San Diego Co.: 1 ♀, Jacumba, 29 June 1963 (T. Botton; BBSL); 5 ♀♀, 1 ♂, 6 mi E Banner, 13 July 1963 (W.C. Reische; UCD); 19 ♀♀, same except (J.D. Birchim; CAS); 1 ♀, Scissors Crossing, 4 July 1956 (L.A. Stange; LACM). NEVADA, Clark Co.: 1 ♂, Mesquite, Mar. 1953 (G.E. Bohart, BBSL), "from tubular nests"; 2 ♀♀, 1 ♂, Glendale, 27 Apr. 1973 (F. Parker and P. Torchio; BBSL), on *Sphaeralcea* (1 ♀) and *Acacia* (1 ♀, 1 ♂). MEXICO, BAJA CALIFORNIA: 1 ♀, Las Arrastras de Arriola, 29 June 1961 (R. Maynard and J. Honey; LACM); 1 ♀, 13 km NW Rosarito, 9 Sept. 1977 (R.R. Snelling; LACM); 2 ♀♀, 14 km S Rosarito, 9 Sept. 1977 (E.M. Fisher and R. L. Westcott; CAS).

Known plant associations for *C. browni* consist of the following. ASCLEPIADACEAE: *Asclepias* sp. BORAGINACEAE: *Plagiobothrys* sp. CACTACEAE: *Opuntia* sp. FABACEAE: *Acacia* sp., *A. greggii*, *Dalea* sp. (*Psoralea*?), *Melilotus alba*, *Prosopis glandulosa*, *P. g.* var. *torreyana*. FRANKENIACEAE: *Frankenia palmeri*. HYDROPHYLACEAE: *Eriodictyon angustifolium*. KOEBERLINIACEAE: *Canotia* sp. TAMARICACEAE: *Tamarix pentandra*.

Chalicodoma (Chelostomoides) chilopsidis (Cockerell)

Figures 59, 60

Lithurgus oblongus W. Fox, 1893:20; ♀. Preoccupied.

Megachile chilopsidis Cockerell, 1900:17; ♀.

Megachile longula W. Fox, 1902:137. New name for *L. oblongus* W. Fox.

Megachile pratti Cockerell, 1913:541; ♂.

Megachile (Chelostomoides) chilopsidis: Mitchell, 1956:126–130, 135, 136; ♀♂.

Fox's original name for this species remains a secondary homonym, even after having been transferred from *Megachile* (where it was preoccupied by *M. oblonga* F. Smith, 1879) to *Chalicodoma*; the primary homonymic species is also a *Chalicodoma* (Michener, 1965). For further description of this species, see Mitchell (1956).

Female clypeal configuration (Figs. 52, 53) is diagnostic for this sex. Males are less easily separated from others without both a ventral mandibular process and a median clypeal tubercle. Among these species, however, the presence of conspicuous, dark hairs interspersed among the pale hairs of the clypeus is diagnostic for *C. chilopsidis* males. Also useful in recognizing males is the conspicuously bi-

dentate carina of tergum 6 and the polished integument between the punctures of the vertex and mesosomal dorsum.

From the superficially similar *C. adelphodonta*, *C. chilopsidis* males are separable by the greater interspace between the teeth of the carina of tergum 6 and by the second flagellar segment being about 2.5 times longer than the minimum length of the first (less than twice as long in *C. adelphodonta*); *C. adelphodonta* males lack anterior patches of flocculent hairs on the mesoscutum. Another similar species is *C. discorhina*, the male of which has a wholly flat clypeus, rather than convex over the basal one-half or more.

This is a Creosote Scrub desert species, ranging from western Texas to southern California and across the adjacent northern states in Mexico. It is a primarily vernal bee, mostly flying from April to June.

Floral visits for nectar and/or pollen are recorded within 25 plant genera representing 11 families, Fabaceae predominating. The known floral records, for nectar and/or pollen, for *C. chilopsidis* consist of the following. ASTERACEAE: *Cirsium* sp., *Encelia farinosa*, *Helianthus* sp., *H. annuus*, *Senecio* sp., *Verbesina encelioides*. BIGNONIACEAE: *Chilopsis linearis*. BORAGINACEAE: *Heliotropium curassavicum*. FABACEAE: *Acacia greggii*, *Cercidium floridum*, *C. microphyllum*, *C. peninsulare*, *Hoffmannseggia microphylla*, *Medicago sativa*, *Melilotus* sp., *Parkinsonia aculeata*, *Prosopis glandulosa*, *P. g. var. torreyana*, *P. velutina*, *Psorothamnus arborescens var. simplifolius*, *P. californica*, *P. spinosus*. HYDROPHYLLACEAE: *Phacelia ramosissima*. LAMIACEAE: *Hyptis emoryi*, *Marrubium vulgare*. MALVACEAE: *Sphaeralcea* sp. ROSACEAE: *Vauquelinia* sp. SAPINDACEAE: *Sapindus* sp., *S. saponaria var. drummondii*. SCROPHULARIACEAE: *Cordylanthus littoralis*. ZYGOPHYLLACEAE: *Larrea tridentata*.

Chalicodoma (Chelostomoides) discorhina (Cockerell)

Figures 63, 64

Megachile discorhina Cockerell, 1924:549; ♀.

Megachile (Chelostomoides) discorhina: Mitchell, 1934:384, 404–405; ♀. Mitchell, 1956:131, 135, 136; ♀♂.

A Creosote Scrub desert species, *C. discorhina* ranges from New Mexico to southern California. Although I have seen no specimens from the state of Sonora, Mexico, *C. discorhina* surely is present there. In Lower California, it is known from both Baja California and Baja California Sur.

As usual in *Chelostomoides*, the bizarre clypeal and mandibular modifications of females of this species (Figs. 63, 64) are distinctive. The male most closely resembles that of *C. chilopsidis* but differs immediately in the wholly flat clypeus and the lack

of dark hairs among the whitish clypeal pubescence. There is also a similarity to *C. adelphodonta*, a species that lacks patches of flocculent hairs at the anterior portion of the mesoscutum. For a complete description of this species, see Mitchell (1934).

Floral visits, for nectar and/or pollen, have been recorded for 18 plant genera, representing eight families; most records are within the family Fabaceae. Hurd and Linsley (1975) noted that "... females commonly take pollen from *Larrea* ..." and "also visit *Cercidium* and, to a lesser extent, *Acacia* and *Prosopis*." Known floral associations for *C. discorhina* are as follows. ASTERACEAE: *Baileya* sp., *Encelia farinosa*, *Senecio* sp. BRASSICACEAE: *Lepidium* sp. CAPPARIDACEAE: *Isomeris arboorea*. FABACEAE: *Acacia greggii*, *Cercidium* sp., *C. floridum*, *C. microphyllum*, *C. peninsulare*, *Coursetia* sp., *Hoffmannseggia microphylla*, *Medicago sativa*, *Melilotus* sp., *Parkinsonia aculeata*, *Prosopis glandulosa*, *P. g. var. torreyanum*, *Psorothamnus schottii*. LAMIACEAE: *Hyptis emoryi*. MALVACEAE: *Sphaeralcea* sp., *S. ambigua*. TAMARICACEAE: *Tamarix gallica*. ZYGOPHYLLACEAE: *Larrea tridentata*.

In southern California, the flight period is late March and April, and in Arizona is April through early June.

The parasitoid *Leucospis affinis* Say (Leucospidae) has been reared from a nest of *C. discorhina* (Hurd, 1979).

Chalicodoma (Chelostomoides) lobatifrons (Cockerell)

Figures 9, 65, 66

Megachile lobatifrons Cockerell, 1924:547; ♀♂.

Megachile (Chelostomoides) lobatifrons: Mitchell, 1937:384, 385, 406–408; ♀♂. Mitchell, 1956:132, 134, 136; ♀♂.

Females of *C. lobatifrons* are recognizable by the presence of a dorsal mandibular process and the distinctive clypeal form (Figs. 65, 66). The male is readily identifiable by the unique, very narrow process of the carina of tergum 6 (Fig. 9). For further description, see Mitchell (1937, 1956).

This is a Creosote Scrub desert species ranging from New Mexico to southern California and adjacent areas of Mexico. Floral records are few. Known pollen and/or nectar sources include plants of 10 genera, representing six families.

Following are the known floral associations of *C. lobatifrons*. ASTERACEAE: *Viguera longifolia*. CAPPARIDACEAE: *Wislizenia refracta*. EUPHORBIACEAE: *Euphorbia albomarginata*. FABACEAE: *Acacia greggii*, *Cercidium* sp., *Olneya tesota*, *Prosopis glandulosa var. torreyana*, *P. pubescens*, *P. velutina*, *Psorothamnus emoryi*. POLYGONACEAE: *Eriogonum fasciculatum*, *E. inflatum*, *E. trichopes*. ZYGOPHYLLACEAE: *Larrea tridentata*.

Available records indicate a flight period extend-

ing from late May to early July. A female collected at Salton Sea State Park, Imperial Co., California, was provisioning a nest in a gall on *Encelia*.

Chalicodoma (Chelostomoides)
odontostoma (Cockerell)

Figures 3, 6, 56

Megachile odontostoma Cockerell, 1924:550; ♀.
Megachile (Chelostomoides) duplexa Mitchell, 1934:353; ♂. Mitchell, 1937:385, 411; ♂.
Megachile (Chelostomoides) odontostoma: Mitchell, 1937:383; ♀. Mitchell, 1956:131, 134, 136; ♀♂.

The prominent, narrow, acute lateral clypeal lobes of the female are distinctive (Fig. 56). The male, among those lacking a ventral mandibular process, may be recognized by the weakly bilobate carina of tergum 6 (Fig. 6), the lack of a median tubercle on the clypeal margin (Fig. 3), the presence of flocculent patches on the mesoscutum, and the distinctly tessellate surface of the vertex. See Mitchell (1937, 1956) for further description.

This species ranges through the Creosote Scrub desert, from western Texas to southern California and in adjacent areas of northern Mexico. Although there are no substantiating records, it probably occurs in southern Nevada.

Floral records are few but include 21 genera in nine families. Following are the known floral associations for *C. odontostoma*. ASCLEPIADACEAE: *Asclepias* sp., *A. erosa*. ASTERACEAE: *Aster* sp., *Baileya* sp., *Chaenactis stevioides*, *Encelia* sp., *E. farinosa*, *Geraea canescens*, *Helianthus* sp., *Palafoxia linearis*, *Senecio* sp., *Verbesina encelioides*. BORAGINACEAE: *Heliotropium curasavicum*. BRASSICACEAE: *Lepidium* sp., *Lesquerella* sp. FABACEAE: *Acacia greggii*, *Cercidium floridum*, *Medicago sativa*, *Melilotus* sp., *Prosopis glandulosa*, *P. g. var. torreyanum*, *P. velutina*. HYDROPHYLLACEAE: *Phacelia* sp. MALVACEAE: *Sphaeralcea* sp. TAMARICACEAE: *Tamarix gallica*.

Flight records extend from late March to mid-May.

Chalicodoma (Chelostomoides)
rugifrons (F. Smith)

Chelostoma rugifrons F. Smith, 1854:220; ♀.
Chelostomoides rugifrons: Cockerell, 1904:301; ♀.
Megachile rufimanus Robertson, 1891:65; ♀♂.
Megachile (Chelostomoides) rugifrons: Mitchell, 1937:384, 385, 412–414; ♀♂. Mitchell, 1956:135, 137; ♀♂.

This is the only eastern species in which the female clypeus is modified and the mandibles are slender and tridentate. The male lacks a ventral mandibular process, the carina of tergum 6 is weakly bilobate, and the ocellular distance is distinctly shorter than the ocelloccipital distance. In both sexes, the

punctures of the vertex are unusually coarse. For further description, see Mitchell (1937, 1956).

The range of *C. rugifrons* extends from Virginia and Michigan south to Florida and westward to Nebraska, Kansas, Oklahoma, and Texas.

Floral records for nectar and/or pollen include plants of 14 genera, belonging to 10 families. Known floral associations of *C. rugifrons* are as follows. APOCYNACEAE: *Apocynum* sp. ASTERACEAE: *Coreopsis* sp., *Erigeron* sp. ERICACEAE: *Vaccinium* sp. FABACEAE: *Lotus* sp., *Psoralea* sp., *Tephrosia* sp. HYPERICACEAE: *Hypericum* sp. LAMIACEAE: *Blephilia* sp., *Nepeta* sp. LOBELIACEAE: *Lobelia* sp. PONTEDERIACEAE: *Pontederia* sp. SCROPHULARIACEAE: *Veronicastrum virginicum*. VERBENACEAE: *Verbena* sp.

According to Mitchell (1962), the flight period is April to July.

Groups VII–X

The following four groups represent species that do not appear to belong to any of the preceding five groups. As a whole they share the following suite of characters: male mandible slender, tridentate, and without ventral process; hypostomal acetabulum absent; male procoxa without apical process; male protarsal segments slender and basal segments densely setose on inner side; female clypeus variously modified; female tergum 6 without preapical groove; mesoscutum of both sexes without notaular patches or transverse anterior band of flocculent hairs.

Group VII (*manni* Group)

This group includes a single, poorly known species, *C. manni* (Mitchell), known only from a few specimens from southern Arizona. The female clypeus is beveled and transversely bowed across the basal facet, the lower facet is oblique and simple; the apical margin is fully exposed, straight, and without denticles. The mandible is stout and quadridentate (or weakly quinquedentate). Tergum 6 has a transverse preapical carina, but it is not preceded by a groove as in female members of Group I (*exilis* group).

The presumed male of *C. manni* has a median denticle on the clypeal margin and larger, sublateral denticles. Tergum 6 has a low, obsolete carina that is weakly emarginate in the middle, and the apical margin is without lateral or submedian teeth.

Chalicodoma (Chelostomoides)
manni (Mitchell)

Figure 53

Megachile (Chelostomoides) manni Mitchell, 1934: 355; ♀♂. Mitchell, 1937:409; ♀♂. Mitchell, 1956: 134, 136; ♀♂.
Chalicodoma (Chelostomoides) manni: Hurd, 1979: 2075.

This rare species is known only from a few specimens from the Huachuca Mountains of southern Arizona. See Mitchell (1934, 1937, 1956) for descriptions of this species.

Group VIII (*texensis* Group)

GROUP CHARACTERS. Female clypeus with conical preapical process and anterior margin with prominent submedian tubercles (Figs. 54, 67); male clypeal margin without denticles or tubercles; male frons dull and contiguously punctate; mesoscutum of both sexes shiny between uniformly subcontiguous punctures.

INCLUDED SPECIES. *Chalicodoma axyx*, n. sp., and *C. texensis* (Mitchell).

One species (*C. texensis*) ranges from southern Texas and central Mexico south to Costa Rica; in Mexico it ranges west to the Pacific Coast. The other species is presently known only from Costa Rica.

Chalicodoma (Chelostomoides) *axyx*, new species

Figures 19, 21, 25, 27, 33–35, 67, 68

DIAGNOSIS

Female mandible long and slender, with three apical teeth and with prominent conical, preapical process, the margin between the conical process and the innermost of the apical teeth deeply concave and much shorter than the apical width of the mandible (Fig. 21); otherwise similar to female of *C. texensis*, but legs usually ferruginous or light reddish brown. Male similar to that of *C. texensis*, but legs ferruginous; pro- and mesotarsi with dense fringe of white hairs along posterior margin of basitarsus that are longer than their segment.

DESCRIPTION

FEMALE. Measurements (mm): HOLOTYPE HW 3.23; HL 2.50; WL 6.7; TL 10.2. Paratypes: HW 2.87–3.49; HL 2.36–2.72; WL 5.7–7.2; TL 8.9–12.0.

Generally similar to female of *C. texensis*, as described below, but with postmedian tooth of upper margin of mandible prominent and margin between it and innermost apical tooth distinctly concave and shorter than apical width of mandible (Fig. 21). Clypeal structure as in *C. texensis*, but disc rugosopunctate, with narrow, shiny, impunctate area across basal margin. Supraclypeal area weakly elevated and with coarser, contiguous punctures. Frons and vertex similar to those areas of *C. texensis* but frons rugosopunctate. Gena, in profile, about three-fourths as wide as eye, shiny between subcontiguous fine punctures. Pedicel about twice longer than first flagellar segment and a little less than twice longer than second. Interocellar and ocellocular distances subequal and greater than ocellocapital distance.

Mesosoma, metasoma, and pubescence as in *C. texensis*.

Color of head and body blackish brown; mandible dark reddish near apex; scape, pedicel, and upper side of flagellum brownish, underside of flagellum lighter. Tegula transparent yellowish red. Femora and tibiae light ferruginous; tarsal segments dusky.

MALE. Measurements (mm): Allotype HW 2.86; HL 2.29; WL 5.9; TL 9.3. Paratypes: HW 2.71–3.33; HL 2.05–2.67; WL 5.5–6.7; TL 7.5–10.4.

Head 1.25–1.32 times as broad as long; eyes weakly convergent below, upper interorbital distance about 1.1 times lower interorbital distance; in frontal view, preoccipital margin arcuately produced above ocelli by less than transverse diameter of anterior ocellus. Mandible as described for *C. texensis*. Labrum as described for *C. texensis*, but impunctate area limited to basal one-fourth to one-third. Clypeus as described for *C. texensis* but very weakly produced in middle, and median impunctate line weak or absent. Supraclypeal area, frons, vertex, preocciput, and gena as described for *C. texensis*. Pedicel and first two flagellar segments as described for *C. texensis*. Interocellar distance greater than ocellocular distance, each distinctly greater than ocellocapital distance.

Mesoscutal interspaces moderately shiny, distinctly tessellate, punctures subcontiguous to dense; mesosoma otherwise as described for *C. texensis*.

Legs as described for *C. texensis*, but mesobasitarsal fringe long (Fig. 25).

Metasoma as described for *C. texensis*, but carina of tergum 6 low and shallowly emarginate in middle; hidden sterna and genitalia (Figs. 27, 33–35).

Pilosity as described for *C. texensis*, but posterior margins of pro- and mesobasitarsi with sparse fringe of yellowish hairs that are conspicuously longer than the segment.

Color as described for *C. texensis*, but femora and tibiae ferruginous.

TYPE MATERIAL

Holotype female: Hacienda Comelco, 24 km NW Cañas, Guanacaste, COSTA RICA, 59 m elev., 16 Feb. 1972 (E.R. Heithaus, no. 18451), on flowers of *Andira inermis*, 1200–1215 hr. Allotype, same locality, collector (no. 19013), and host plant, 6 Mar. 1972, 1045–1120 hr. Paratypes (all Guanacaste Province, COSTA RICA): 44 ♀♀, 3 ♂♂, same locality and collector as holotype, 12 Feb. 1972 (7 ♀♀, 3 ♂♂, on *Caesalpinia eriostachys*), 14 Feb. 1972 (2 ♀♀, on *C. eriostachys*), 16 Feb. 1972. (2 ♀♀, on *C. eriostachys*), 6 Mar. 1972 (7 ♀♀, on *A. inermis*), and 9 Mar (26 ♀♀, on *A. inermis*); 6 ♀♀, 7 km N Cañas, 15 Feb. 1966 (D.H. Janzen), on flowers of *Gliricidia sepium*; 4 ♀♀, 2 mi S Liberia, 2 Mar. 1973, on *A. inermis*, 1 ♀, 29 Dec. 1972, on *C. eriostachys*, and 1 ♀, 30 Dec. 1972, on *Myrospermum frutescens* (all G.W. Frankie); Liberia, 15–16 Feb. 1972 (82 ♀♀, 13 ♂♂, on *A. inermis*), 23–26 Feb. 1972 (50

♀♀, 2 ♂♂, on *A. inermis*, 1 ♀, on *Dalbergia retusa*, 1 ♀, on *Tabebuia rosea*), 1 Mar. 1972 (5 ♀♀, on *A. inermis*) (all P.A. Opler); Hacienda Comelco, 8 km NW Bagaces, 8–9 Jan. 1973 (3 ♂♂, on *Simaruba glauca*), 22 Jan. 1972 (1 ♂, on *G. sepium*), 24–25 Jan. 1972 (2 ♂♂, on *Byrsonima* sp.), 29 Jan. 1972 (3 ♂♂, on *Securidaca sylvestris*), 10 Feb. 1972 (17 ♀♀, on *Pterocarpus rohrii*), 6 Mar. 1971 (1 ♀, on *D. retusa*), 25 Mar. 1972 (12 ♀♀, on *Lonchocarpus costaricensis*), 17 Apr. 1971 (1 ♀, on *D. retusa*), 25 Nov. 1972 (5 ♀♀, 5 ♂♂, on *A. inermis*), 28 Dec. 1972 (2 ♂♂, on *C. eriostachys*) (all P.A. Opler); Bagaces, 4 Mar. 1974 (P.A. Opler), 2 ♀♀, on *A. inermis*; Finca La Pacifica, 4 mi NW Cañas, 25–30 Jan. 1972 (2 ♀♀, 1 ♂, on *M. frutescens*), 12 Feb. 1972 (1 ♂, on *Inga* sp.), 14 Mar. 1973 (3 ♀♀, 3 ♂♂, on *D. retusa*) (all P.A. Opler); 1 km W Río Blanco, 15 Apr. 1971 (P.A. Opler), 3 ♀♀, on *D. retusa*. Holotype and allotype in LACM; paratypes in LACM, TAMU, UCB, UKAN, and USNM.

ETYMOLOGY

The specific name is an arbitrary combination.

DISCUSSION

There is little variation in the long series of paratypes studied; the differences in size are noted above in the description. The form of the female clypeal apex is unique to this species and *C. texensis*; in *C. axyx* the clypeal disc is much more closely punctate, usually appearing rugosopunctate, than in *C. texensis*. The most important difference between the females is the much stronger submedian angulation of the upper margin of the mandible in *C. axyx*, with the deep concavity following it distinctly shorter than the apical width of the mandible (Fig. 21); in *C. texensis* the concavity is shallow and is longer than the apical width of the mandible (Fig. 22). While both sexes of *C. axyx* generally have conspicuously ferruginous legs, a few have the legs brownish infusate, and this character must be used with caution. Males of *C. axyx* differ consistently from those of *C. texensis* by the dense fringe of long, plumose hairs on the pro- and mesobasitarsi; most of the hairs of the fringe are distinctly longer than the basitarsus from which they arise.

The floral records presently available for *C. axyx* represent five families. BIGNONIACEAE: *Tabebuia rosea*. FABACEAE: *Andira inermis*, *Caesalpinia eriostachys*, *Dalbergia retusa*, *Gliricidia sepium*, *Inga* sp., *Lonchocarpus costaricensis*, *Myroslpermum frutescens*, *Pterocarpus rohrii*. MALPIGHIACEAE: *Byrsonima* sp. POLYGALACEAE: *Securidaca sylvestris*. SIMARUBACEAE: *Simaruba glauca*.

Chalicodoma (*Chelostomoides*) *texensis* (Mitchell)

Figures 10, 22, 26, 37, 54

Megachile (*Chelostomoides*) *texensis* Mitchell, 1956:132–133; ♀.

This species was described from a single female collected at Southmost, Cameron Co., Texas; the type is in the USNM, and I have examined it. Although *C. texensis* barely enters the United States, it is widely distributed in Mexico and extends south to Costa Rica.

The male has not been previously described and both sexes are redescribed to provide a comparative basis for the very similar *C. axyx*, described above. Costa Rican females differ from those of Mexico (and the type) in having larger and stouter submedian clypeal tubercles and the process of the disc blunter (Fig. 54). Males from the two areas are more similar, but those from Costa Rica are, on the average, more densely punctate on the frons and vertex.

DESCRIPTION

FEMALE. Measurements (mm): HW 2.92–3.28; HL 2.31–2.62; WL 6.0–6.5; TL 9.0–10.5.

Head (Fig. 54) about 1.3 times as broad as long; inner eye margins weakly divergent below, upper interorbital distance about 0.8 times lower interorbital distance; in frontal view, vertex strongly elevated above eyes and ocelli. Mandible slender, with three distinct apical teeth and an obscure denticle in second interspace; submedian angulation of upper margin weak, margin between it and third tooth shallowly concave and about as long as apical width of mandible (Fig. 22). Sides of labrum mostly subparallel, narrowed preapically; apical margin transverse; with median preapical seta-pit with cluster of long, reddish setae and small pit on either side with a single long seta arising from each. Clypeal margin broadly concave, with a pair of prominent submedian denticles; disc elevated along midline, with large conoid projection above and between submedian denticles of margin (Fig. 57); disc shiny between subcontiguous to contiguous coarse punctures, impunctate in middle. Supraclypeal area slightly elevated toward base of clypeus, punctuation similar to that of clypeus. Punctuation of frons, vertex, preocciput, and gena as in male but interspaces shiny. Pedicel about 1.5 times longer than either first or second flagellar segments. Interocellar distance greater than ocellocular distance; ocellocular distance equal to, or a little greater than, ocellocapital distance.

Mesoscutum and scutellum as in male but interspaces shiny; mesepisternum shiny between subcontiguous to dense, moderate punctures; metepisternum and side of propodeum moderately shiny between moderate, subcontiguous punctures; remainder of propodeum as in male.

Disc of first two terga moderately shiny between fine, subcontiguous to dense punctures; third and fourth terga similar but punctures less distinct, more separated; punctures of fifth tergum a little coarser, dense; sixth tergum finely, subcontiguously punctate, without preapical groove.

Pubescence about as in other *Chelostomoides*.

Clypeal hairs sparse, a few at sides somewhat brownish; supraclypeal area with a few brownish hairs interspersed among usual white hairs; hairs brownish on vertex and occiput and with some scattered brownish hairs on mesoscutum and scutellum; pronotal collar and mesoscutum without definite patches of flocculent hairs; first five terga with apical fringes of short, flocculent, appressed, white hairs; second and third terga with pubescent fasciae in basal gradular depression; discs of second to fifth terga with blackish pubescence only; sixth tergum wholly dark pubescent; scopa slightly yellowish, except blackish on apical segment.

MALE. Measurements (mm): HW 2.76–3.29; HL 2.14–2.52; WL 5.8–6.4; TL 8.0–10.5.

Head about 1.3 times as broad as long; inner eye margins weakly convergent below, upper interorbital distance about 1.1 times lower interorbital distance; in frontal view preoccipital margin arcuately produced above ocelli by less than transverse diameter of anterior ocellus. Mandible without ventral process; apex tridentate, inner tooth on same plane as first and second teeth. Lateral margins of labrum slightly convergent apicad, apex truncate, disc shiny, nearly impunctate on basal one-half or less, integument slightly roughened between fine, dense punctures on distal one-half or more. Clypeus weakly convex, apical margin weakly produced in middle and shallowly emarginate, shorter than length of lateral margin between process and angle at eye margin; punctures of disc contiguous, fine to moderate over most of disc, becoming fine to minute toward apical margin; median impunctate line present but often weak, interspaces smooth and shiny. Supraclypeal area and frons slightly shiny, variably finely rugosopunctate to contiguously punctate; vertex and preocciput slightly shiny between fine contiguous to subcontiguous punctures. Gena about half as wide as eye in profile, shiny between fine contiguous to subcontiguous punctures. Pedicel about as long as first flagellar segment; first flagellar segment distinctly broader than long and about one-half as long as second flagellar segment. Interocellar and ocellocular distances subequal and longer than ocelloccipital distance.

Mesoscutum and scutellum moderately shiny and weakly tessellate between subcontiguous fine to moderate punctures; metanotum less shiny, punctures fine and close to dense; mesepisternal punctation similar to mesoscutum but interspaces a little less shiny; side of propodeum slightly shiny and roughened between obscure, contiguous to subcontiguous, fine punctures.

Anterior face of procoxa with abundant long, erect, plumose hairs; without apical process. Probasitarsus slender and simple, without mastigion; second protarsal segment about one-third as long as first, asymmetrical; last protarsal segment distinctly shorter than first.

Metasomal terga 1–4 shiny, but not polished between very irregularly spaced fine to moderate punctures; tergum 5 similar but subcontiguously

punctate; tergum 6 similar but contiguously punctate, carina bilobate, apical margin without lateral or submedian teeth or angles. Exposed sterna slightly to moderately shiny between mostly subcontiguous, fine to moderate punctures.

Pilosity erect, mostly white and conspicuously plumose; long, brownish to blackish hairs abundant on clypeus, frons and vertex, posterior one-third of mesoscutum and scutellum. Discs of metasomal terga 2–5 with sparse, very short, suberect brownish hairs; tergum 6 with short, appressed, plumose, white hairs across base and in depression basad of transverse carina; sternum 3 mostly concealed by dense, appressed, white, plumose hairs. Hairs along posterior margins of pro- and mesobasitarsi (Fig. 26) sparse and not forming a definite fringe.

Color of head and body blackish, but tergum 6 and sterna 2–3 mostly light ferruginous; appendages brownish, underside of flagellum and tarsi ferruginous. Wings clear, veins and stigma light to medium brown.

In addition to the type, I have seen the following specimens of *C. texensis*. UNITED STATES, TEXAS: 3 ♂♂, Southmost, Cameron Co., 27 Mar. 1951 (L.D. Beamer; UKAN), on *Agastache breviflora*. MEXICO, CHIHUAHUA: 3 ♂♂, Santo Niño, 10 Aug. 1968 (T.C. Sears, R.C. Gardner, C.S. Glaser; UCD). JALISCO: 1 ♀, Estación Biología de "Chamela," 9 Apr. 1982 (S.H. Bullock No. 932; LACM); 3 ♀♀, same locality and collector, 12 and 19 May 1980. PUEBLA: 1 ♀, 4 mi NW Choix, 17 July 1968 (T.C. Sears, R.C. Gardner, C.S. Glaser, UCD); 1 ♀, 1 ♂, same locality and collectors, 31 Aug. 1968. SONORA: 2 ♂♂, 5 mi E Navojoa, 2 Aug. 1960 (Arnaud, Ross, Rentz; CAS); 1 ♂, Río Cuchuhuqui, 7 mi S Alamos, 25 July–7 Aug. 1953 (F.S. Truxal; LACM). VERA CRUZ: 2 ♀♀, Eypantla, 12 Mar. 1981 (J.L. Neff; NEFF), at nests in beetle burrows in post of ramada. YUCATÁN: 1 ♀, Uxmal ruins, 14 Feb. 1987 (C.D. Michener; UKAN); 1 ♂, Koban, 25 km SW Ticul, 14 Feb. 1987 (C.D. Michener; UKAN); 5 ♀♀, 4 ♂♂, Yodronot, 16 Feb. 1987 (C.D. Michener; UKAN). COSTA RICA, GUANACASTE: 1 ♀, 8 ♂♂, Finca La Pacifica, 4 km NW Cañas, 14 Mar. 1973 (P.A. Opler; UCB), on *Dalbergia retusa*; 1 ♀, 4 mi N Cañas, 15 Feb. 1966 (D.H. Janzen; UKAN), on *Gliricidia sepium*; 1 ♀, 1 ♂, Hacienda Comelco, 24 km NW Cañas, 14 Feb. 1972 (E.R. Heithaus; LACM), on *Caesalpinia erio-stachys*, 1015 hr; 3 ♀♀, same locality and collector, 6 Mar. 1972, on *Andira inermis*, 1045–1120 hr; 2 ♀♀, same locality and collector, 9 Mar. 1972, on *A. inermis*, 0745–0815 hr; 1 ♂, Hacienda Comelco, 8 km NW Bagaces, 22 Jan. 1972 (P.A. Opler; UCB), on *G. sepium*; 1 ♀, 1 ♂, same locality and collector, 25 Mar. 1972, on *Lonchocarpus costaricensis*; 5 ♀♀, 1 ♂, same locality and collector, 28 Dec. 1972, on *C. erio-stachys*; 1 ♀, Bagaces, 4 Mar. 1974 (P.A. Opler; UCB), on *A. inermis*; 1 ♀, Río Blanco, 15 Apr. 1971 (P.A. Opler; UCB), on *A. inermis*; 3 ♀♀, 5 ♂♂, same locality and collector, 23–26 Feb. 1972, on *A. inermis*; 2 ♂♂, same locality and collector, 1

Mar. 1972, on *A. inermis*; 1 ♀, 2 mi N Liberia, 2 Mar. 1972 (G.W. Frankie; TAMU), on *A. inermis*, 1330-1345 hr.

The type female was reportedly collected on flowers of *Parkinsonia* sp.; all available floral records are from the family Fabaceae.

Group IX (*adelphodonta* Group)

This group includes only *C. adelphodonta*, a species known only from southern Arizona and from Lower California, Mexico. The female is easily recognized by the flat clypeus, the apical margin of which is broadly excised on either side of a broad, apically tridentate, median lobe (Fig. 55). The male is similar to those of Group V males, but the carina of tergum 6 is bidentate, with the teeth close together, the clypeus and frons are shiny between well-defined, subcontiguous punctures, the mesoscutum lacks flocculent hair patches, and the first flagellar segment is about one-half as long as the second.

Chalicodoma (*Chelostomoides*) *adelphodonta* (Cockerell)

Figures 11, 55

Megachile adelphodonta Cockerell, 1924:548; ♂.
Megachile (*Chelostomoides*) *tucsonensis* Mitchell, 1956:133; ♀.

Cockerell (1924) described *M. adelphodonta* from a single male collected at Guadalupe Point, Bahia Concepcion, Baja California Sur, Mexico. The type locality of *M. tucsonensis* is Tucson, Arizona, and is also based on a single specimen. A number of specimens of both sexes are available and appear to confirm the above synonymy by Hurd (1979). For further description of *C. adelphodonta*, see Mitchell (1956).

In addition to the types of *M. adelphodonta* and *M. tucsonensis*, I have seen the following specimens. UNITED STATES, ARIZONA: 1 ♀, 1 mi N Portal, Cochise Co., 23-24 Aug. 1973 (E.G. and J.M. Linsley; UCB), on *Larrea divaricata*, 1030-1059 hr; 1 ♀, Sycamore Canyon, near Ruby, Santa Cruz Co., 16-17 Aug. 1961 (F. Werner and J. Bequaert; UNAR); 1 ♀, 3 mi W Oracle, Pima Co., 12 June 1961 (Werner, Bequaert, and Noller; UNAR); 2 ♂♂, Florida Canyon, Santa Rita Mts., Pima Co., 20 Aug. 1961 (Wargo; UNAR), on Arizona poppy (*Argemone* sp.); 1 ♂ Ruby, Santa Cruz Co., 16 Aug. 1961 (J.C. Bequaert; UNAR); 1 ♀, 1 ♂, 5.5 mi W Peña Blanca, Santa Cruz Co., 17 Aug. 1961 (F. Werner and J. Bequaert; UNAR); 1 ♀, 5 mi S Amado, Santa Cruz Co., 2 Sept. 1977 (E.G. and J.M. Linsley; UCR), taking nectar of *Kallstroemia grandiflora*, 0830-0859 hr. MEXICO, BAJA CALIFORNIA SUR: 2 ♂♂, 35 mi N Loreto, 5 Oct. 1975 (R.R. Snelling; LACM), on *Wislizenia refracta*; 1 ♂, 10 km W Ramal Los Naranjos, 26 Aug. 1982 (Faulkner and Brown; SDM). SONORA: 1 ♂, 3 mi NE San Carlos, 22 Mar. 1967 (E.M. Fisher; LACM).

Including the above, known floral data for *C.*

adelphodonta consist of the following records. ASTERACEAE: *Helianthus annuus*. CAPPARIDACEAE: *Wislizenia refracta*. FABACEAE: *Dalea albiflora*, *Prosopis glandulosa* var. *torreyana*, *Psoralea scoparius*. NYCTAGINACEAE: *Allionia* sp. PAPAVERACEAE: *Argemone* sp. ZYGOPHYLLACEAE: *Kallstroemia grandiflora*, *Larrea divaricata*.

Group X (*ecplectica* Group)

GROUP CHARACTERS. Female clypeus bizarre and gena with secondary carina parallel with hypostomal carina; female without transverse preapical groove on tergum 6. Male unknown.

INCLUDED SPECIES. *Chalicodoma ecplectica*, n. sp. The only known species in this group is known only from southern Mexico. The male is unknown.

Chalicodoma (*Chelostomoides*) *ecplectica*, new species

Figures 73, 74

DIAGNOSIS

Known from the female only, this species is separable from all known American *Chalicodoma* by the presence of a sharp cariniform ridge parallel to the hypostomal carina. In addition, the head is unusually broad, the eyes are strongly divergent below, and the clypeus is beveled, with the upper lateral lobes projecting as a tooth-like process (Fig. 73) on either side.

DESCRIPTION

FEMALE. Measurements (mm): Holotype HW 4.03; HL 2.97; WL 8.3; TL 10.0.

Head (Fig. 73) about 1.3 times as broad as long; inner eye margins strongly divergent below, lower interorbital distance about 1.3 times upper interorbital distance and about 1.4 times eye length; in frontal view, vertex greatly elevated above eyes and ocelli. Mandible slender, apical margin tridentate and about one-fourth as long as lower margin. Hypostomal area, laterad of hypostomal carina, with strong, cariniform ridge extending from outer mandibular base to occipital depression and parallel to hypostomal carina, broad interspace slightly concave, smooth and shiny. Labrum broad at base, margins convergent distad. Clypeus protuberant and bifaced (Fig. 74), lower face smooth and shiny, apical margin simple and not covering base of labrum; upper face with middle lobe transverse and slightly emarginate, separated from lateral lobe by shallow emargination, lateral lobe with oblique corniform process; upper face mostly smooth and shiny but with some moderate to coarse, setigerous punctures. Supraclypeal area shiny between fine to moderate, contiguous to subcontiguous punctures. Frons, vertex, and preocciput dull, punctures coarse and contiguous; gena similar but with interspaces shiny between moderate punctures. Pedicel longer

than first or second flagellar segments, first broader than long; second flagellar segment about 1.3 times longer than first. Interocellar distance about 1.8 times diameter of anterior ocellus and about 0.6 times ocellocular distance; ocellocipital distance about 1.1 times ocellocular distance.

Pretegular carina of pronotum not extending entirely across pronotal lobe. Mesoscutum shiny between contiguous to subcontiguous, moderate to very coarse punctures; scutellum similar but punctures more commonly subcontiguous; mesepisternum similar, punctures mostly contiguous in middle, becoming mostly subcontiguous ventrad; metepisternum and side of propodeum contiguously, finely punctate; propodeal triangle rugosopunctate across base, remainder dull and minutely granulose.

Discs of metasomal terga progressively more shiny distad, punctures moderate and contiguous on first, mostly subcontiguous on remaining segments; last tergum dull, contiguously punctate, without preapical groove.

Pubescence about as in other *Chelostomoides* but clypeus with sparse simple hairs only; pronotal collar and front of mesoscutum without dense, flocculent, long hairs; first five metasomal terga with dense apical fasciae of short, plumose hairs; disc of sixth tergum with pale hairs; scopa pale, including that of sixth sternum.

TYPE MATERIAL

Holotype female: 11.4 mi W Chilpancingo, 7700 ft elev., GUERRERO, MEXICO, 31 July 1969 (University of Kansas Mexican Expedition), in Snow Entomological Museum, University of Kansas. Paratype: 1 ♀, 13 km W Chilpancingo, 31 July 1969 (G. Byers, D. Kamm) in LACM.

ETYMOLOGY

The specific name is derived from the Greek *ekplektikos* (astounding or marvelous) and stresses the bizarre cephalic features of this species.

DISCUSSION

The unusual cephalic characteristics of *C. ecplectica* will immediately separate this species from all others. Particularly distinctive is the presence of the cariniform ridge bordering the hypostomal area; this feature is unique within *Chelostomoides*. Until a male can be associated with *C. ecplectica* nothing can be said of the relationship of this species to other *Chelostomoides*.

Chelostomoidella, new subgenus

DIAGNOSIS

Differs from *Chelostomoides*, the only other native North American subgenus of *Chalicodoma*, by the following unique features: mandible with thin, transparent lamella, parallel to surface of trimma

and above it (visible only when mandible is fully opened, larger in male) (Figs. 17, 18); male mandible with process of lower margin located basad; male with prominent, suberect, subbasal, spine-like tubercle on ventral surface of procoxa in addition to that at apex; male mesosternum with a submedian pair of sharp, suberect spiniform tubercles behind procoxa; female mandible with outer ridge and secondary ridge strong from base to near teeth, the two ridges only moderately convergent distad, groove between them broad and deep; preapical groove of female sternum 6 very deep, preceded and followed by transverse carinae.

DESCRIPTION

FEMALE. [1] Mandible broad, apical margin much more than one-half as long as lower margin; with four or five teeth, interspaces without beveled cutting edges; outer ridge and secondary ridge both strong, continuous from near base to near apical teeth, groove between them broad, flat; base with thin, transparent, prostrate lamella above trimma (visible only when mandible is fully opened). [2] Clypeus weakly convex, apical margin overhanging base of labrum and broadly, shallowly emarginate in middle, with median tubercle. [3] First flagellar segment shorter than second. [4] Lower genal area simple.

[5] Meso- and metabasitarsi shorter and narrower than corresponding tibiae; tarsal claws simple.

[6] Mesosoma parallel-sided; tergum 6 with very deep preapical groove, basal face, in profile, projecting over groove as cariniform ridge, posterior carina present.

MALE. [7] Mandible broad, tridentate, inner tooth larger than middle tooth and approximately perpendicular to outer margin; ventral process basal; base with thin, transparent, prostrate lamella lying over trimma (Figs. 16, 17). [8] First flagellar segment shorter than second.

[9] Procoxa glabrous beneath, with slender, suberect, discal, spine-like process near base, in addition to larger apical process. [10] Protarsal segments 1–3 greatly expanded, anterior margin of first and second segments with deep, longitudinal channel. [11] Meso- and metabasitarsi shorter and narrower than corresponding tibiae; tarsal claws symmetrical.

[12] Carina of tergum 6 (Fig. 13) with a pair of submedian, long, apically truncate spines; posterior margin with lateral and submedian spines long, acute. [13] Sternum 3 with narrow median row of short, fully erect, spine-like setae over distal one-half. [14] Sternum 4 fully retracted, simple. [15] Sternum 5 (Fig. 48) glabrous except for fringe of short, plumose hairs at apicolateral margin; metasternite very large and extended over lateral parts of poststernite as a broad, membranous flap. [16] Sternum 6 (Fig. 49) with a pair of short submedian carinae, ending distally in tooth-like process, their entire length surmounted by closely ranked, erect, compressed setae; at base of distal tooth-like pro-

cess, a double row of closely ranked, compressed setae extending laterad on each side; poststernite present as a large apically emarginate, very delicate lobe, with transverse wrinkles near base and with scattered short, prostrate setae with reflexed apices, and with a row along distal, incurved margin, and laterad with sparse, fine, simple setae. [17] Gonocoxite (Fig. 47) compressed distad, compressed part slightly bent laterad and its inner margin with sparse, long, simple setae. [18] Volsella with long, slender outer lobe, inner angle subtruncate to broadly rounded (Fig. 47). [19] Aedeagus (Fig. 47) distinctly shorter than gonocoxite, largely thin and transparent over distal one-half.

TYPE-SPECIES

Megachile (Chelostomoides) spinotulata Mitchell, 1934.

ETYMOLOGY

The name is a diminutive form of *Chelostomoides*.

DISCUSSION

This subgenus is monobasic; the only species has previously been included within the subgenus *Chelostomoides*. This one species possesses so many unique features, especially in the male, that I am convinced it must be removed from *Chelostomoides*.

Both sexes share many features with the species of *Chelostomoides* but immediately differ in the presence of a thin, transparent lamella overlying a shallow depression at the base of the trimma. This lamella is not visible when the mandibles are closed. Species of *Chelostomoides* lack both the transparent lamella and the depression at the base of the trimma.

The male of *C. spinotulata* is uniquely different from that of *Chelostomoides* in the glabrous, bispinose ventral surface of the procoxa, the presence of mesosternal spines, the median row of coarse setae on the third sternum, the glabrous fifth sternum, and the blunt, spiniform processes of the carina of tergum 6.

Females of *C. spinotulata* are much less bizarre than males of this species but do differ from those of *Chelostomoides* in a few unique characters other than the presence of the trimmal lamella. The outer face of the mandible is similar to that of the broad mandible forms of *Chelostomoides*. But, in such species the outer ridge is low and broad and, while often extending nearly the full length of the mandible, is always somewhat evanescent, or fully interrupted, at some point beyond the basal one-third. The secondary ridge is normally distinct over the basal one-third, and is greatly reduced or absent beyond. The broad interspace between these ridges is usually flat, but very shallow. In *Chelostomoidella* both ridges are strong and complete from the man-

dible base to the base of the teeth; because of their elevation, the interspace between them is deep.

Although females of some *Chelostomoides* do possess a preapical groove on the sixth tergum, it is marked only distad by a bordering cariniform ridge. When the sixth tergum of *C. spinotulata* is seen in profile, the basal face partially overhangs the groove; the margin of this extended portion is thin and somewhat carina-like; beyond the posterior carina, the segment is strongly convex and descends abruptly to the translucent posterior margin of the segment.

Chalicodoma (Chelostomoidella) spinotulata (Mitchell)

Figures 13, 16, 17, 47–50

Megachile (Chelostomoides) spinotulata Mitchell, 1934:357–359; ♀♂

Megachile (Chelostomoides) subspinotulata Mitchell, 1934:360–361; ♀. NEW SYNONYMY.

It is now apparent that *C. subspinotulata* is a synonym of *C. spinotulata*. The differences in size, clypeal dentition and mandibular structure noted by Mitchell (1934) at the time of the original descriptions, are fully bridged by the material I have seen. The inner tooth of the mandible may be truncate at the apex, thus resulting in the four-toothed mandible of *C. subspinotulata*. In *C. spinotulata* the inner tooth is deeply emarginate at the apex; the mandible appears to be five-toothed. Most specimens are intermediate in this character, and their assignment to one or the other name becomes ambivalent.

The structure of the apical margin of the clypeus is variable in this species, as it is in the species of *Chelostomoides*. This is especially true of the width and depth of the median emargination and of the size of the median tubercle.

This species ranges from southern California to western Texas. The following records extend the range of *C. spinotulata* into northwestern MEXICO, BAJA CALIFORNIA SUR: 1 ♀, Cañon de Zorra, 260 m elev., 11 km W Santiago, 4–5 Sept. 1977 (R.R. Snelling; LACM), on *Parkinsonia aculeata*; 1 ♀, 19 km NW Mulegé, 8 Sept. 1977 (R.R. Snelling; LACM), on *Hoffmanseggia* sp.; 1 ♂, 4 km N Los Barriles, 10 m elev., 4 Sept. 1977 (R.R. Snelling; LACM). CHIHUAHUA: 1 ♀, Santa Clara Canyon, 5 mi W Parrita, 1 Sept. 1956 (J.W. MacSwain; UCB).

Floral visits, for nectar and/or pollen, include plants of 30 genera belonging to 18 families. The following are known floral associations of *C. spinotulata*, in addition to those cited above. ASCLEPIADACEAE: *Asclepias erosa*. ASTERACEAE: *Chrysopsis fastigiata*, *Chrysothamnus* sp., *Helianthus* sp., *Lepidospartum squamatum*, *Senecio* sp. BORAGINACEAE: *Cryptantha* sp. EUPHORBIACEAE: *Croton californicum*, *Euphorbia* sp. FABACEAE: *Cercidium* sp., *C. peninsulare*, *Lotus* spp. (5), *Lupinus* sp., *Phaseolus wrightii*, *Prosopis glan-*

dulosa torreyana, *P. velutina*, *Psorothamnus californica*, *P. fremontii*. GENTIANACEAE: *Swertia perryi*. GERANIACEAE: *Geranium* sp. HYDROPHYLLACEAE: *Eriodictyon* sp., *Phacelia ramosissima*. LAMIACEAE: *Marrubium vulgare*. LILIACEAE: *Calochortus splendens*. LOASACEAE: *Mentzelia* sp., *M. laevicaulis*. NYCTAGINACEAE: *Allionia* sp., *Boerhavia spicata*. POLEMONIACEAE: *Gilia* sp. POLYGONACEAE: *Eriogonum* spp. (4). RANUNCULACEAE: *Clematis drummondii*. SAPINDACEAE: *Sapindus* sp. SCROPHULARIACEAE: *Cordylanthus* sp., *C. filifolius*, *C. nevinii*, *C. rigidus*. ZYGOPHYLLACEAE: *Larrea tridentata*.

This is mainly a late summer- and fall-flying species. *Leucospis affinis* Say (Leucospidae) has been recorded as a parasite (Hurd, 1979).

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